SCIENTIFIC AMERICAN

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ALL MAY HAVE TELEPHONES.

On the 30th day of January, 1894, the Bell telephone patent expired and the invention became the property of the public; so that whoever desires to do so can make, buy or sell telephones without fear of infringing the rights of any one. This applies only to the hand instrument now used as a receiver. Patents for other telephone apparatus still remain in force; but enough is available for actual service. With two hand instruments and a suitable call, telephonic communication may be maintained, under favorable conditions, over a line eight or ten miles long, no battery being required.

To avoid the effects of induction and to secure the best results, a metallic circuit is required. It has been said, on good authority, that with hand telephones used as transmitter and receiver, conversation has been carried on between New York and Chicago, using a metallic circuit formed of heavy copper wire and having very low resistance. The words, it is said, were as distinct as where a transmitter is used, but the volume of sound was somewhat less.

For the benefit of those who are desirous of making telephones for their own use, or for sale, we present perspective and sectional views of the latest and most improved form of telephone, all of the parts of which are shown exactly full size.

The handle is made of hard rubber and the cap, which is also the mouthpiece, is of hard rubber. The diaphragm, A, is clamped at the edge between the cap or mouthpiece and the body of the handle. Very thin ferrotype plate has generally been used for the diaphragm, but thin taggers iron, when protected by a coat of shellac or other suitable varnish, is said to answer better.

The compound magnet, B, used in the telephone, is composed of four thin flat bar magnets, *a*, arranged in pairs on opposite sides of the flat end of the soft iron pole piece, *c*, at one end, and the soft iron distance piece, *d*, at the opposite end, the magnets being clamped to these pieces, with like poles all in one di-

(*Continued on page 70.*)

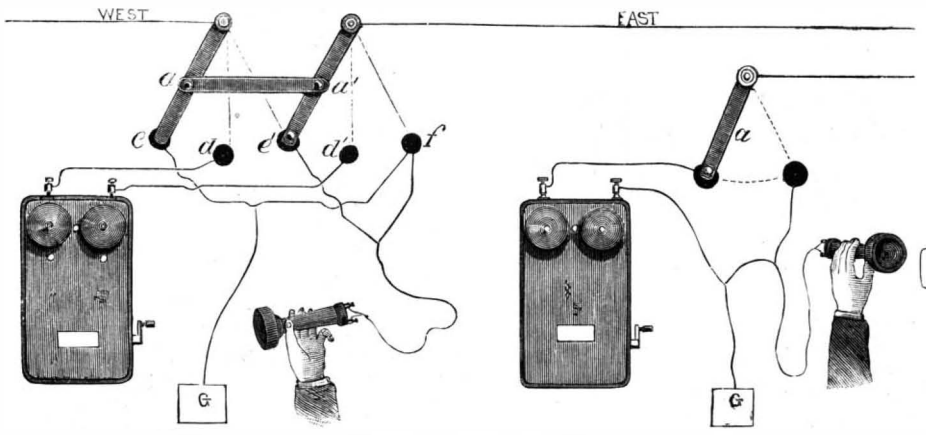


Fig. 2. SINGLE WIRE CIRCUIT. Fig. 3.

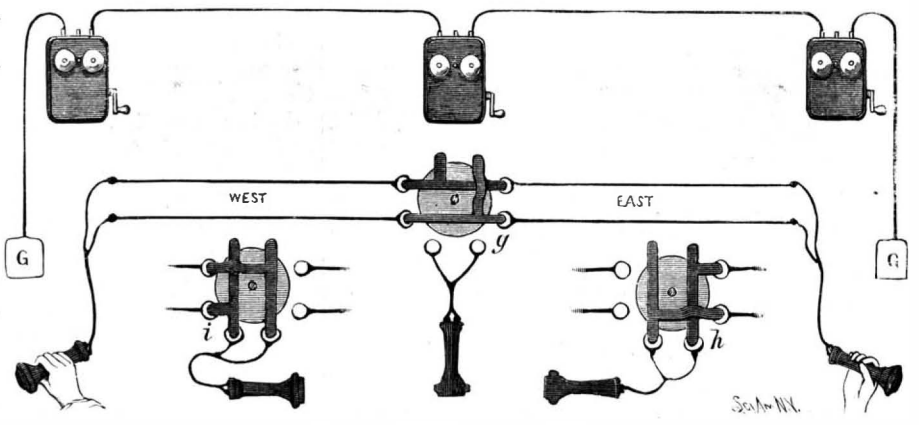
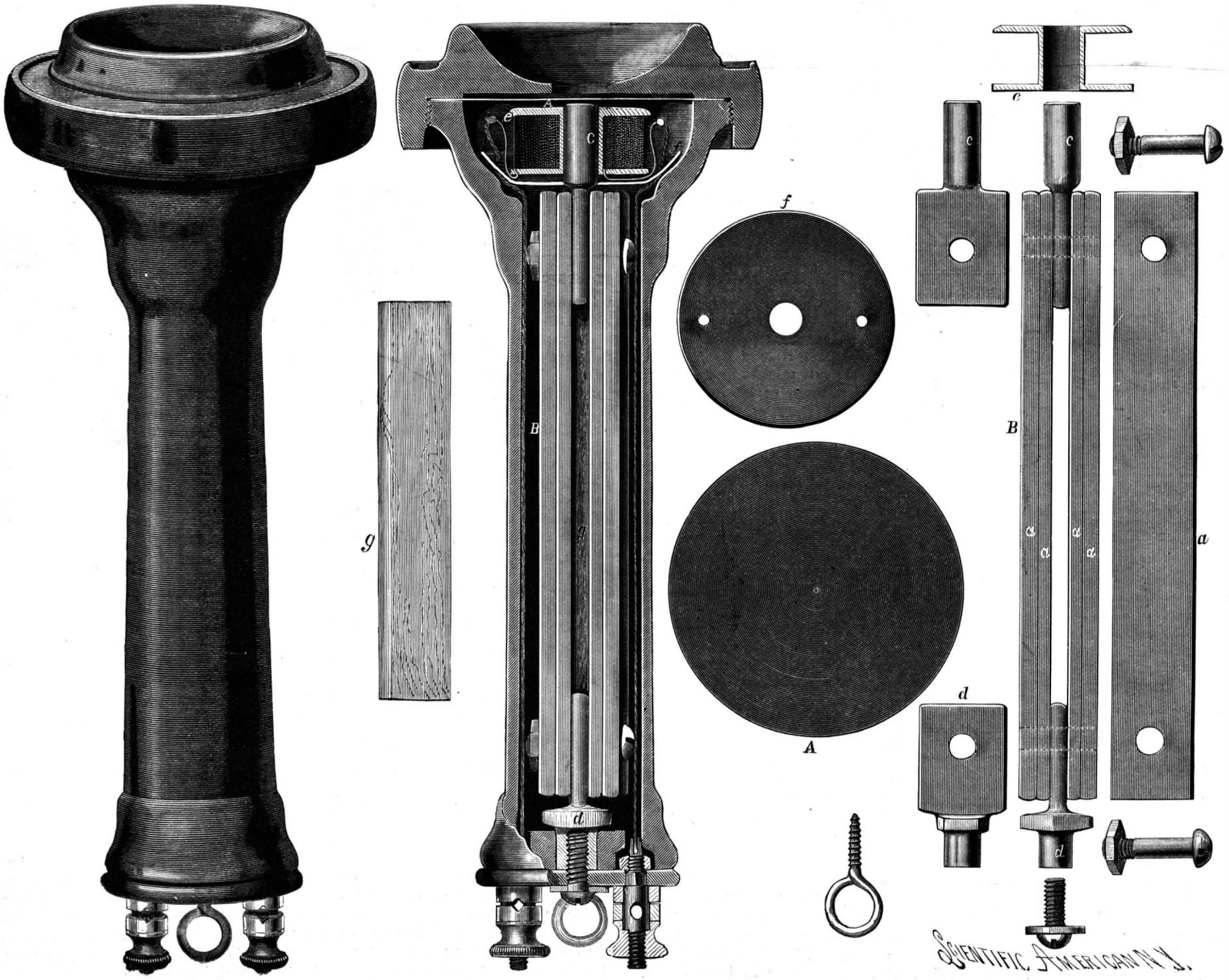


Fig. 4.—METALLIC CIRCUIT.



DETAILS OF CONSTRUCTION OF THE BELL TELEPHONE.

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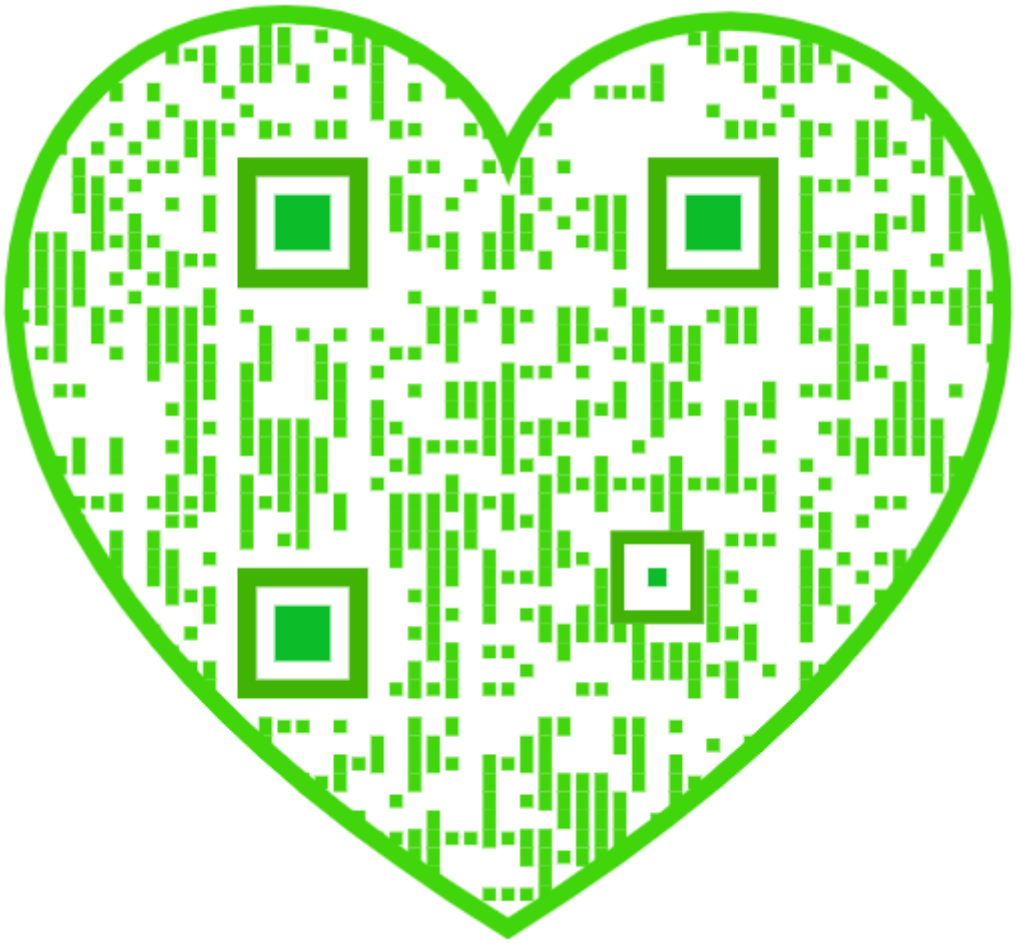

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FOREIGNERS ARE LEARNING OUR INDUSTRIAL METHODS.

It has long been our boast that America was able to produce better results in the technical field than those due to any other nation; even where hand work is concerned, this is believed to hold true in many respects. If it is simply a question of adhering to tradition and of reproducing the products originated by past generations, the foreign workman may equal or surpass the American. But it has long been remarked that where originality and an ability of thinking and working on independent lines is involved, the foreign highly specialized workman yields to the more independent American mechanic, as to one less hampered by tradition. Thus we find our country abounding in self-made men who began at the lathe and bench, and now own and conduct great factories. Their independent habits of thought have opened for them their careers.

Inventiveness, the great American characteristic, has had much to do with this state of affairs. The constant striving after invention, the introduction of ingenious machines and labor-saving processes, has relegated the old-country machine-like workman to the past. His work is done here by machinery, and those who attend the machines may be destined to be the inventors of others designed to surpass them. While hand-made goods, from their very imperfections, have a charm for the artist, the every-day user appreciates rather the constant good quality of machine-made articles. Our superior methods have given us the power of competing under primarily unfavorable conditions with the cheaper labor of foreign countries.

It is a question how long the supremacy of our methods will last. Foreign competitors in the industrial world have for some time past realized the fact that certain American-made articles sell better than their own; indeed, they find a similar state of things obtaining in many lines of manufactures. One way of meeting the case is resorted to in the production of counterfeit American goods. Discreditable as it is, there is no question that extensive operations of this character have been carried on.

But a more honorable way of meeting what seems to be a true emergency has been adopted. English manufacturers now send over students of our manufacturing processes, in the persons of intelligent young men, who enter our shops as workmen and labor there, studying meanwhile and learning all the details of our shop management and manufacturing processes. The United States is, in fact, treated as a technical school. The men sent pass from one factory to another, so as to get a good view of different processes. Then they return and use their knowledge to advance their own home industries.

In almost every field of technical work America has won renown. It is now evident that our neighbors are determined to find out why this is, and the placing of students in our shops is a tribute of the highest value to our methods of work.

THE ORIGINAL EDISON ELECTRIC RAILROAD.

We reproduce elsewhere an interesting illustration from the SCIENTIFIC AMERICAN of June 5, 1880. The cut represents Edison's electric railroad as operated at that time in Menlo Park, N. J., a station on the Pennsylvania Railroad, in those days celebrated as the abode of Edison and the site of his laboratory. The Wizard of Menlo Park, as he was then called, made the place illustrious by his work on the incandescent electric light and the first or "tin-foil" phonograph. As he left the train a short flight of steps or steep path led the visitor up a bank by the side of the track, and a few minutes walk on the more level ground brought him to the laboratory. Here Edison with his corps of assistants was at work on a variety of operations in the many branches of science which have always been carried on in his laboratories.

The inventions then being developed were from time to time described by us, the original phonograph making one of its earliest appearances in public in the office of the SCIENTIFIC AMERICAN, and being first described in our columns.

The year 1880 is an ancient period in electric engineering. To-day we see the horse-drawn street car disappearing from our streets, the local traffic of steam railroads transferred in great part to a new system of travel, and areas of country brought within frequent and rapid communication by a new agency. This element in transportation is the electric road. Starting from humble beginnings, deriving its energy originally from primary batteries in the days of Page, then using the rails or an insufficiently insulated conductor laid between the tracks for the transfer of mechanically generated electric energy; next using the overhead wire with trolley running upon it, and finally reaching its present efficient, if objectionable, form of trolley pole pushing up against the under surface of a conductor, the electric road has reached a position of first importance in local traffic, and may yet displace the steam locomotive on long distance work. In ten years a new element has entered our life and a new profession has been created.

The cut which we reproduce has a special interest for us at this day. It shows the electric railroad of 1880. If the next ten years witness as great progress in electric railroads as the last decade has sufficed for, the face of the country will be revolutionized.

The peculiar features of the primitive installation will be noticed. The use of frictional gear for throwing the motor on and off, the small traction car distinct from the passenger car, and the use of the rails as conductors are characteristic. It is curious that fourteen years have sufficed to produce relics in this engine and car which are as antiquated in regard to modern work as is the De Witt Clinton when compared with modern locomotives.

We feel that we cannot do better in the way of contributing to ancient history than to reproduce the text of the article describing this affair. The last paragraph is interesting, showing how hazardous it seemed to prophesy what the future has actually brought forth.

FIGHTING MAN'S MOST DEADLY FOES.

For two or three years past there have been indications, increasing in number, that chemists in many lands (one or more even in far-off Japan) are at last giving their minds and their labors to the study of the chemistry of the bacteria.

Already we have a probable working hypothesis, which furnishes a valuable guide to the chemist in this field. This is the view, which must at least involve much truth, that all bacterian diseases are the results of blood poisoning by certain products or educts of the growth of the bacteria, after these have effected a lodgment in the tissues of the body.

On this hypothesis have been based several methods of experiment, which we have not space for now. Our present object is to sustain assertions made above, by citing, as an example, results announced during the last year, on the authority of two German chemists, Wernicke and Behring. They found that the poisons of both the diphtheria and the tetanus (lockjaw) microbes were neutralized, after being introduced into the circulation of animals, by introducing also iodine trichloride. It appeared also that this compound acted as an actual antidote to the blood poison, inasmuch as it did not kill the bacteria themselves, while preventing them from killing the animal. To say the least, this is a most encouraging result, and justifies the hope expressed in the previous article referred to, that if these enemies cannot yet be actually destroyed, their baneful and debilitating agencies may be neutralized, so that the vital energies may have a chance to combat and overcome them. Experiments on men in this direction have been promised, and will be awaited with interest.

Test of Holtzer Projectiles.

The reception test of the second lot of 100 ten-inch armor-piercing Holtzer shells took place January 18 at the Sandy Hook proving grounds. The shells were made by the Midvale Steel Company, of Pennsylvania, after the celebrated French process. The gun used was a ten-inch breech-loading rifle, mounted on a barbette carriage. The steel armor plate was one which had been used before, having been made by the Bethlehem Company. It weighed 10 tons and was 11½ inches thick. Two shots were fired, each weighing 575 pounds. The charge was 183 pounds of powder. The test was highly successful, the plate and its oak backing three feet thick was pierced with ease, and the projectile was lost in the sand bank, but was afterward recovered and calipered. The gauges and calipers were passed along the shot and failed to reveal the slightest variation in length or thickness. The velocity was 1,625 feet per second. A crack in the plate almost imperceptible before firing was widely opened by the shot. The edges of the hole were turned out like rose leaves and the steel surrounding the hole was blued by the heat generated by impact of the shell.

Artificial Sunlight.

In a dark room with alternating currents of 800,000 voltage, Nikola Tesla, by means of atmospheric vibrations, caused a faint glow of light to appear. Explaining the phenomenon, he said: "If I can increase the atmospheric vibrations, say 1,000,000 or ten thousand millions, I can produce sunlight in this room. Of course, I can increase the vibrations by increasing the voltage. I can make the voltage 8,000,000 as easily as 800,000; but I am not ready to handle 8,000,000 volts of electricity. Currents of such strength would kill everybody in the room. I expect, however, to learn how to control a large voltage. When I have increased the atmospheric vibrations perhaps a thousand times, the phenomenon will be no longer electricity. It will be light. I am satisfied that sunlight can be made from electricity without doing harm to anybody, and I expect to discover how it is done. It is a grand idea, and whether the voice through which it came be hushed and still or yet resounds in the proclamations of new truths, the idea itself will be carried to fruitage, and the world will be wiser, whatever may be the issue."

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The Niagara Hydraulic Works in Operation.

The first practical test of the hydraulic tunnel which has been under construction at Niagara Falls for the past three years, was made on the 25th of January.

The test afforded a practical demonstration of the new works, which have already cost nearly $4,000,000. The Niagara Falls Paper Mill, which is the first to get the benefit of the power, is the largest of its kind in the world. Its contract calls for 6,600 horse power, one-half of which is being used now, and the cost, including the lease of the land occupied by the mill, is $8 per horse power per year, for twenty-four hours per day, the cheapest, it is said, ever obtained. The mill is now in full operation.

The hydraulic tunnel has a capacity of 120,000 horse power. The formal opening of the general power house, where 5,000 horse power turbines will operate 5,000 horse power electric generators for the transmission of power, will take place on June 1, and it is intended to give the event a celebration at which distinguished scientists, engineers, and state officials will be present.

Harvard Observatory in Peru—the Highest Meteorological Station in the World.

We are indebted to Dr. S. I. Bailey, of the Harvard Observatory, Arequipa, Peru, for a copy of *La Bolsa*, of that city, containing an account by him of the establishment of the Harvard Meteorological Station on the summit of Misti, not far from Arequipa.

We translate the following abstract: "Well knowing the interest which Peruvians take in scientific progress, and especially in all observations made in connection with the famous volcano of Arequipa, I have the pleasure of giving you the following particulars concerning the meteorological station recently established on the summit of Misti. In order to equip and put this station into operation, a road for mules was very much desired; for, although one might be able to go on foot to the summit once or twice, it would be very difficult, without such a road, for an intelligent person to visit the station regularly and make the necessary observations. The experience of persons who have ascended to great heights has been, in general, that the fatigue due to the extraordinary exertions has disabled them from making exact observations. We have never heard it said that mules have ascended to so great a height as the summit of Misti; but previous experience with these animals at heights of 17,000 feet convinced me that, with proper care, mules might ascend to a height of 19,000 or even 20,000 feet.

Of all the mountains in the neighborhood of Arequipa, Misti, by its splendid isolation and symmetry, is the most adequate for a prominent meteorological station.

In August last an expedition was sent out to make the complete circuit of this volcano, with the object of studying the possibility of making a mule road to the top. Minute observations were made with good telescopes of all sides of the mountain, and we took some photographs. Seen from whatever direction, Misti presents a surprising symmetry, always showing a cone more or less truncated, but almost perfect. This examination convinced me the mountain was accessible from the northeast. In August a stone cabin was erected on the northeast side of the volcano as a station, and here I stayed several days watching the construction of the road to the summit. Without leaving the great slopes of volcanic sand and avoiding the sharp rocks, it did not prove to be an impossible enterprise, as many have feared.

On the 27th of September I had the pleasure of reaching the summit with my assistant, several Indians and two mules. Going on foot and on mule back alternately, we arrived in good condition to make scientific observations, and the mules were not seriously injured. The altitude, however, produced a great effect upon the mules, and when near the top they refused to go more than twenty steps at a time without taking a good rest. Without such extreme care, it is probable they would have succumbed.

On the 12th of October I returned to visit the summit with two members of the observatory, twelve Indians, and thirty mules, transporting a portable house of wood, with double walls. We also carried a small house for instruments, together with the instruments necessary for the station work. Provisions were sent to our stone cabin, where we pass the night at an altitude of 16,000 feet, more or less; without this precaution the ascension would have been impossible. Some of the members of the committee suffered seriously from breath exhaustion (*soroche*), and only by great exertions did the men and mules succeed in reaching the summit. In many places it was necessary that two men should assist each of the mules that bore the heavy parts of the house. On this expedition one of the mules stumbled and went down a rocky declivity and was considerably hurt; happily its burden consisted of clothing and other articles which were not damaged by the fall.

The station consists at present of two little houses, one for the observers and the other for the instruments. They have been located at a short distance from the iron cross, which, for more than a century, has formed so fitting a crown for the mountain. The station is provided with an automatic barometer, indicator, thermograph, hygrometer and anemometer, together with various mercurial thermometers. The first named automatic instruments run ten days, and a member of the observatory will visit the station three times a month.

The height of the station, according to determinations made by various barometric observations, is 19,300 feet above the level of the sea.

For the government and citizens of the country who have so generously lent their assistance and confidence to this observatory, it ought to be a matter of pride that Peru not only possesses some of the sublimest scenery, but also has given to science the highest meteorological station in the world.

New Pier of the American Line.

On the Hudson River, at the foot of Fulton St., New York, is situated the new pier of the American Line, which is one of the finest in America. It is situated in the immediate vicinity of the ferry termini of all the railway lines which center in Jersey City and Hoboken. It can also be easily reached by the elevated roads and the cable cars. The new pier is 720 feet long; the piers in use by other lines are about 600 feet long. The width of the American Line pier is 125 feet; that of other piers 70 feet. The pier was specially built to order by the city and the annual rental is $50,000, the lease running for ten years. On this superb pier the American Line Company has erected a huge superstructure at an expense of $300,000. Some of the features of this great shed are new. The building is divided into two stories. From the decks of the steamships the passengers will walk off on an almost horizontal gangway to the second floor, which resembles a large railway waiting room. To any one who has ever crossed the Atlantic or visited a pier either before sailing or on completion of a voyage, the advantage of landing the passengers away from the almost inextricable tangle of cabs, wagons and freight will be apparent. A commodious passenger elevator at the shore end of the pier will add greatly to the comfort of passengers. Special elevators are arranged for baggage. Comfortable waiting rooms are provided, as well as telegraph, cable, and telephone service. The pier is lighted throughout with arc and incandescent lamps. This new pier, in which the comfort of the passenger is carefully considered, will probably be the forerunner of many such piers, and will be in keeping with the five ocean racers which are now being built at the Cramps' shipyard in Philadelphia for this line.

Trial of the Montgomery.

The trial of the partially protected cruiser Montgomery, which took place off New London, January 18, showed a speed of 18·85 knots per hour, without tidal correction, which afterward increased it to 19 knots, so that the contractors (the Columbian Iron Works) will receive $200,000 premium over $612,500, which was the contract price. There were 166 pounds of steam in the boilers and the screws were revolving at a rate of 177 per minute when the first buoy was passed. The number of revolutions was increased to 180. The engines worked smoothly throughout the trial.

The Montgomery is 257 feet long; 37 feet wide; draught, 14½ feet; displacement, 2,000 tons. Two vertical, three-cylinder, triple expansion engines drive the two four-bladed propellers. The indicated horse power is 5,400. A protective deck varying from 0·43 to 0·3 inch thick is provided. The battery is composed of eight 5-inch guns and two 6-inch rapid fire guns. There are also three torpedo-launching outfits and a secondary battery composed of six 6-pounders, two 1-pounders and two machine guns.

George B. Prescott.

The well known electrician and author of electrical works, George B. Prescott, died in New York, January 19, of heart failure. Mr. Prescott was born at Kingston, N. H., in 1830. He became interested in electricity when only a boy and all his life he was actively connected with various telegraph and telephone companies. He made useful improvements both in telegraphy and telephony. He was the joint owner with Thomas A. Edison in all the quadruplex telegraphs. The quadruplex telegraph was introduced by Mr. Prescott. As an author Mr. Prescott was well known and his works served a useful purpose. He advanced the theory that the Aurora Borealis was of electrical origin and interesting accounts of his experiments connected with it were published.

EXCAVATIONS in Oisseau le Petit, Department of the Sarthe, France, have revealed a Gallo-Roman city, which appears to have been destroyed by an earthquake. The city probably contained some 30,000 inhabitants, but its name is not known in French history. The ruins include a great temple, part of which is still standing, also a theater and monuments.

Perpetual Motion of Atoms and Molecules.

Every body is composed of a multitude of extremely, but not infinitely, small molecules, and it might be thought, says Sir R. Ball (according to a contributor in the Newcastle, England, *Chronicle*), that in a solid, at all events, the little particles must be clustered together in a compact mass. But the truth is far more wonderful. Were the sensibility of our eyes increased so as to make them a few million times more powerful, it would be seen that the diamond atoms, which form the perfect gem when aggregated in sufficient myriads, are each in a condition of rapid movement of the most complex description.

Each molecule would be seen swinging to and fro with the utmost violence among the neighboring molecules and quivering from the shocks it receives from the vehement encounters with other molecules, which occur millions of times in each second. The hardness and impenetrability so characteristic would at first sight seem to refute the supposition that it is no more than a cluster of rapidly moving particles; but the well known impenetrability of the gem arises from the fact that, when attempt is made to press a steel point into the stone, it fails because the rapidly moving molecules of the stone batter the metal with such extraordinary vehemence that they refuse to allow it to penetrate or even to mark the crystallized surface. When glass is cut with a diamond, the edge which seems so hard is really composed of rapidly moving atoms. The glass which is cut is also merely a mass of moving molecules, and what seems to happen is that, as the diamond is pressed forward, its several particles, by their superior vigor, drive the little particles of glass out of the way.

Trinidad Asphalt.

Col. F. V. Greene recently read a paper before the American Institute of Mining Engineers that gives some interesting facts about this product. He says:

"The asphalt of Trinidad is found in a so-called lake, situated about 100 feet above the sea and about three miles from the shore of the island, at the village of La Brea (the Spanish word for pitch). Its area is about 114 acres; its depth, as far as ascertained by certain rude borings, is reported to be about 18 feet at the sides and 78 feet in the center; and underlying it there is said to be a bed of blue clay. If these figures are correct, the lake contains about 6,000,000 tons of asphalt. Whether these borings are even approximately accurate is, however, very doubtful. It is even contended by some that the lake is still fed from underground sources. The only positive information on the subject is the fact that the excavations of the last ten years (about 180,000 tons) have not appreciably lowered its level."

The word "lake," applied to this deposit, is an entire misnomer. It is a level tract of brownish material having an earthy appearance. Cracks or fissures having a width and depth of a few feet appear here and there over the surface. Some of them are filled with rain water, while others have been filled with soil blown there by the wind and giving support to a scrubby vegetation. Some travelers have reported that the deposit is liquid in the middle, but such is not the fact. Carts and mules can be driven everywhere on its surface. The material is dug with a pick and shovel, loaded into carts, and hauled to the beach. Here it is placed in baskets, which are carried by coolies wading through the surf to lighters, and from these lighters it is loaded on vessels. During the voyage the material unites in a solid mass, and has to be removed again by the use of pick and shovel. On being unloaded it is placed for about five days in large tanks heated by a slow fire. The moisture is expelled, the roots of trees and other vegetable matters are skimmed off the surface, the earthy matter with which it is combined settles by gravity, and the refined product is run off into barrels. The refining is in reality a mere heating to a liquid condition, in order to allow the sediment to deposit; and great care is taken not to heat the material to a point which will in any way change its chemical condition or produce distillation.

A Top Heavy War Steamer.

Her Majesty's ship Resolution, one of the best war ships in the navy, as was supposed, recently left Plymouth for Gibraltar, was caught in a terrible gale in the Bay of Biscay, and had to put back to Queenstown. It is stated that during the height of the storm she rolled 40 degrees each way, and her deck rails were frequently under water. The ship had to keep her head to the wind for two days, owing to the extreme danger of her capsizing if any attempt were made before the gale abated to turn her head toward port. Two men were washed overboard together, but the captain of the torpedo catcher Gleaner, it is reported, jumped overboard, and, with the assistance of the Resolution's lifeboat, saved one of the men. The other disappeared. It is understood that at times the Resolution was in the gravest danger, being almost unmanageable and at the mercy of the seas which broke over her. Water in hundreds of tons got in the between decks and one of the boats was smashed.

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A SAFETY FENDER FOR STREET CARS.

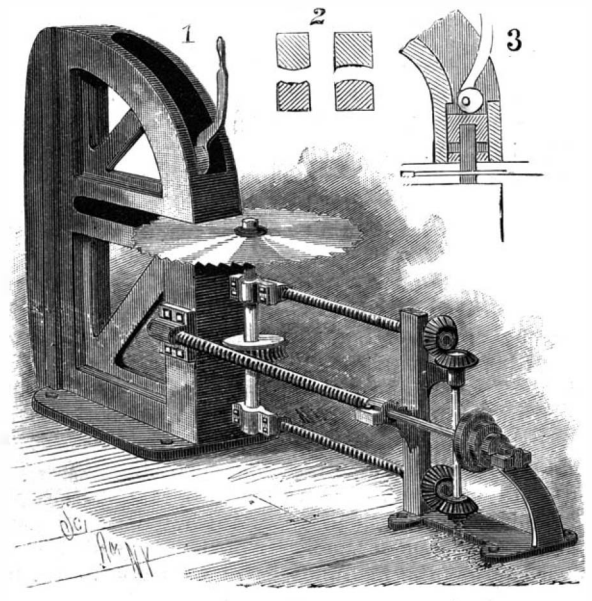
The many run over accidents which have happened since the general introduction of electric and cable cars, to take the place of horse cars, have caused not a few inventors to turn their attention to the devising of some practical means of prevention, in the way of efficient and not too expensive or cumbersome life guards or safety fenders, but as yet nothing has been brought forward which has met with sufficient favor to be generally adopted. Our illustration represents one of these devices, of which a number of successful trials have been made during the past six months. The man picked up by the fender, as shown in the picture, was said to have been struck by the guard when the car was running at the rate of twelve miles an hour, this trial having been made in Brooklyn in October last. This fender has across its front an open-end rubber tube, five inches in diameter, supported at a height

THE ROBINS LIFE GUARD FOR STREET CARS.

of about six inches above the roadway by an elastic steel frame connected by short springs with a hinged fender frame, made of one inch gas pipe, the latter frame being adapted to be folded up against the dashboard to occupy only about ten inches of space, when the car is reversed, or for storage purposes. Wire netting covers the bottom of the frame and extends up in front of the car platform, the netting being attached to the frame by springs, and across the bottom netting, about eight inches from the front end of the fender, is a second rubber guard, ten inches high, this guard having a spring-controlled rearward movement, and being designed to prevent a person from being thrown out of the fender after having been caught up. As the front cross bar of the fender frame proper is eight inches back from the front face of the fender, the blow received by one standing on the track is a cushioned one, and not likely to cause any undue shock or injury. This fender is now being manufactured by the Robins Life Guard & Manufacturing Company, Manhattan Building, Philadelphia, Pa.

A MACHINE FOR STRAIGHTENING SAWS.

This is a strong, inexpensive, and easily operated machine adapted to roll the surface of a saw to make it perfectly level, striking every part of the saw, and adapted also to use compressing blocks for leveling high humps or bunches. The machine has been patented by Mr. Isaac Toomer, of Westlake, La. Fig. 1 shows the machine at work. Fig. 3 is a sectional view illustrating the mechanism forcing the rollers down on the saw, and Fig. 2 shows forms of blocks which may be substituted for the rollers. In the transverse slot in



TOOMER'S MACHINE FOR STRAIGHTENING SAWS.

the front of the frame, through which is passed the saw to be operated upon, are upper and lower bearing blocks in which are journaled the leveling rollers, and the upper block is vertically movable, being forced down to bring the roller with great pressure upon the saw by means of an eccentric having an upwardly extending hand lever. A band saw to be leveled is passed lengthwise between the rollers, but a circular saw is held to revolve by being secured to a head on the upper end of a vertical mandrel turning in suitable boxes which slide on horizontal supports, carrying the mandrel toward and away from the frame, so that every portion of the saw may be brought between the rollers. The saw is revolved as it is operated upon by the revolution of a horizontal screw shaft engaging a worm wheel on the mandrel, the shaft having at its outer end a cone pulley or equivalent driving gear, whereby the speed may be changed as desired. The forward and backward movement of the mandrel is effected by upper and lower horizontal screw shafts connected by beveled pinions with a vertical shaft, on whose lower end, as slightly indicated by dotted lines, is a friction cone, adapted to engage with either one of two cones on a lower horizontal movable shaft, not shown. Any ordinary shifting gear may be employed, and the direction of the screw shafts and of the saw mandrel is thus controlled. The blocks shown in Fig. 2 are substituted for the other bearing bocks and rollers when unusually large inequalities or humps on either side of the saw are to be leveled.

Education the Best Philanthropy.

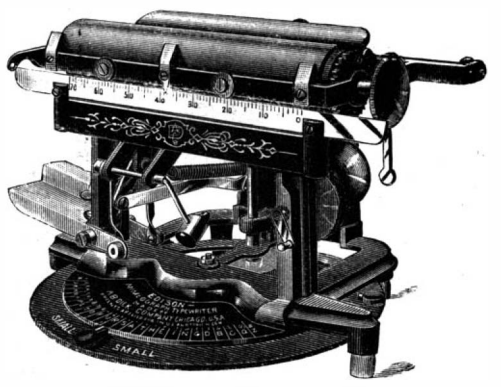
That there are at least three New York ladies who believe in the truth of the above statement—at least so far as it concerns the educational influence of the SCIENTIFIC AMERICAN—we have recently had most flattering evidence. At the beginning of 1893, one of these ladies subscribed for enough copies of the SCIENTIFIC AMERICAN to supply one to each police station in the city, and the paper was thus sent throughout the year. The gift thus made proved so acceptable, and was believed to be productive of so much good, that the subscription is this year renewed, another lady now joining with the originator of the idea, while a third comes forward with a similar subscription for the SCIENTIFIC AMERICAN to be sent for the year to all the fire engine houses of the city. Mrs. D. W. Bishop and Mrs. Stickney are the ladies to whom the police are indebted and Mrs. Joseph M. White is the firemen's friend. The list of police stations to which the paper is thus sent numbers 43 and the fire engine houses 17.

La Grippe.

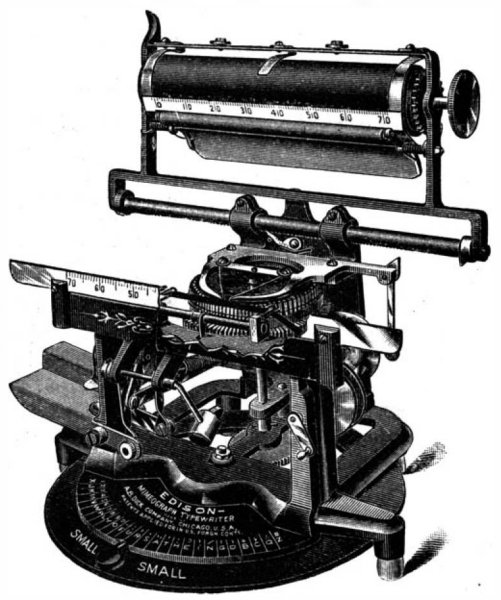
A physician who has just passed through an attack of this distressing disease thus writes to a friend, who communicates it to the New York *Medical Journal*: "Did you ever have this infernal disease that they call the grippe? If not, don't. I have been through it for the last six weeks and am ready to give my friends the benefit of my experience. It is certainly the most diabolical malady that ever got out of Pandora's box. If the old girl has anything worse in reserve, I trust she will keep the lid of her Saratoga safely locked, and then kindly sit on it. Sneeze, freeze to death, burn up, have your energy sapped, let all the clouds of heaven lower over your head, get on familiar terms with all the blue devils that ever escaped by volcanic exit from equatorial eternity—do all this and keep it up for six weeks, and then you can intelligently listen to a lecture on *la grippe*. Cerebration becomes altogether of the too conscious sort for literary work."

A NEW TYPEWRITER.

The Edison Mimeograph typewriter is designed to fill two demands: First, for use in connection with the Edison Mimeograph, for which it cuts a perfect stencil, and, secondly, for general use where a high rate of speed is not required. The machine has been thoroughly tested, and will not, therefore, have to pass through the "experimental stage." It is a typewriter of the familiar type-bar variety, inking direct from a ribbon, but of a mechanical principle different from anything at present existing. The types, which are made of steel, are set in the ends of independent steel bars about an inch long, standing perpendicularly in a circular frame, and having a perpendicular throw of about an eighth of an inch; a revolving disk or frame, having three fixed pointers for the selection of capital letters, small letters or figures and punctuations, moves over the keyboard, carrying in its passage the circular frame holding the type until the letter selected by the pointer on the disk is at the printing point; a universal printing key on the left is lightly touched and the letter selected is thrown against the paper, making an impression. Its extreme simplicity, together with the durability of the machine itself, and the ease with which it may be learned and operated even by one unfamiliar with typewriting machines, are its distinguishing characteristics. A speed of once and a half to twice that of handwriting is easily possible. The machine will be manufactured in three styles, No. 1 having the same letters, figures and characters common in the standard machines, No. 2 having the same type as No. 1, with an additional number and a wider carriage for the admission of paper, and No. 3



Machine in position for writing.



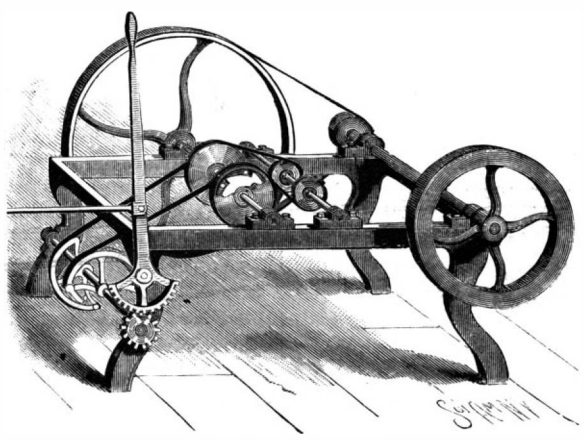
With carriage raised and scale cut away, showing ribbon movement.

THE EDISON MIMEOGRAPH TYPEWRITER.

being equipped with facilities for writing English, French and German. The machine is made by the A. B. Dick Company, Chicago.

AN IMPROVED MOTOR.

This simple and inexpensive construction, to be actuated in different ways by hand, foot, or other power, is designed to transmit the power applied in the most economical manner, being a perfect equalizer, having no dead centers. The improvement has been patented by Mr. C. W. Pearce, of Diller, Neb. In the illustration the device is shown arranged with semicircular rocking treadles loose upon the shaft, and having foot lugs upon their ends for the alternate motions of the feet in driving the mechanism. To render the segmental hand lever available, it is necessary to change the position of the further treadle and secure both treadles firmly to the shaft, when it may be operated by hand, or power may be applied through the connecting rod shown. The segmental rocking treadles are connected by short belts with clutch pulleys mounted to rotate loosely on a driving shaft, and on the rims of the clutch pulleys are secured the ends of belts connected with right and left rock wheels on a shaft journaled in the frame, the right rock wheel being connected with the right clutch and the left rocker, or the inverted one, being connected with the left clutch. As the rock wheels are both keyed to the rock shaft, when the right one moves forward the inverted one moves backward. The clutch employed is a sort of ball or roller device, the rollers clutching the outer rim of the clutch wheels as they are drawn forward, by entering a wedge-shaped opening between the rim and a center piece keyed to the shaft, and when reversing rolling back against the shoulder in the center piece. It is believed that this motor would be an excellent one for electrical purposes, the power being so evenly divided that a light might be produced without a flicker.



PEARCE'S MOTOR.

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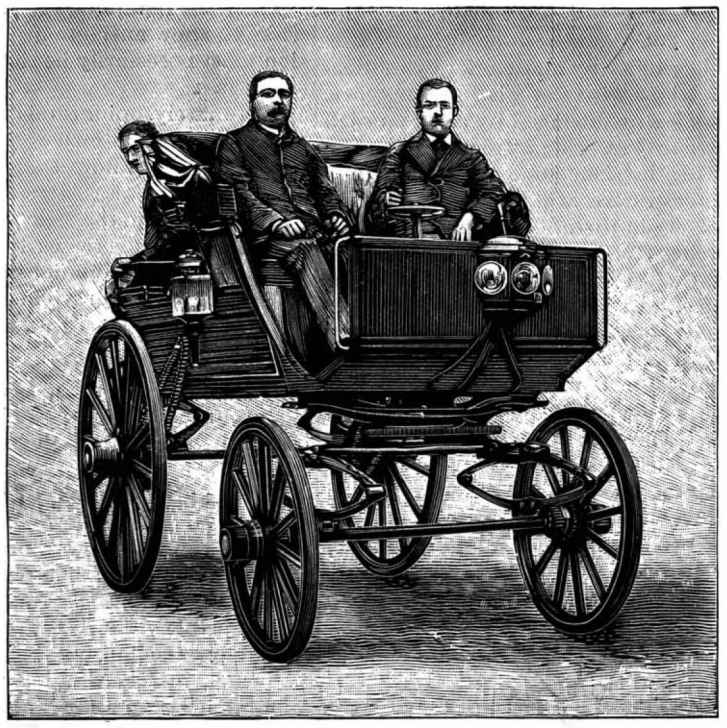
ELECTRIC CARRIAGE.

We have already described in these pages a certain number of electric carriages run by accumulators. The researches in this direction date from the epoch at which the accumulator left the laboratory of its true inventor, our regretted compatriot Gaston Plante, to enter into industrial practice. But the very imperfection of the first types, from the standpoint of the discharge, capacity, solidity and duration of the plates, was the main if not the sole cause of the want of success of the first experiments, which date from 1881. But the progress of accumulators aiding, more recent tentatives have been more fortunate, and as long ago as 1888 we took occasion to present to our readers two improved electric dog-carts that had begun to be employed in England and Turkey.



POUCHAIN'S ELECTRIC CARRIAGE.

The electric carriage that Mr. Paul Pouchain, of Armentieres, has just brought out marks a new stage and seems to come near enough to the solution of the problem to allow us to devote an article to it. This carriage, represented in the accompanying figure, is a phaeton with accommodations for six persons, and is mounted upon four wheels. The whole upper part is movable in order to facilitate the inspection and maintenance of the accumulators and electric motor. The electric current is furnished by a battery of Dujardin accumulators composed of six boxes of nine elements, say in all fifty-four elements Each box is 44 centimeters in length by 33 in width and 31 in height.

Each element contains one positive plate and two negative plates mounted in an ebonite box. The nine elements are coupled in tension in an invariable manner. In order to assure of the hermetical closing of the elements, the box is provided at its upper part with a flange, into which is set an ebonite plate whose dimensions are a little smaller than those of the flange. A rubber plate one millimeter in thickness is fixed to the lower part of the cover and overlaps it by about one centimeter, so that upon applying the cover to the box the rubber turns up and hermetically closes the element. The opening of each element, its inspection, surveillance and its maintenance, are thus greatly facilitated. The nine elements are united in a tarred pitch pine box, thus forming six absolutely independent groups that communicate with a coupling commutator through twelve wires, two per box. This commutator, which is of bronze, constitutes a twelve-sided cylinder, upon ten sides of which are mounted pieces of copper electrically insulated from the body of the commutator, and connected with each other in a permanent manner. Upon acting on a lever, one can give the commutator a rotary motion, and cause it to take five different positions that establish contacts between the pieces of copper and fourteen elastic jaws at which end the twelve wires coming from the six batteries and the two coming from the motor. The connections affected by the commutator in its five positions are as follows:

Position of Rest.—All the accumulators out of circuit. Motor in short circuit forming a brake for the stoppage.

First Position of Velocity.—The six groups mounted in derivation upon the motor (17 volts).

Second Position of Velocity.—Three groups of two in tension (34 volts).

Third Position of Velocity.—Two groups of three in tension (50 volts).

Fourth Position of Velocity.—The six groups in tension (100 volts).

The motor is a series dynamo of the Rechniewski system, of a normal power of 2,000 watts, but which, in case of necessity, is capable of producing twice that power. It is placed in the center of the carriage, and actuates a differential movement through the intermedium of a pitch chain.

Above the hind wheels are arranged four groups of accumulators, the motor and the differential system that controls the wheels. Under the front seat are placed the two other groups, the coupling commutator and a tool box. Against the dashboard are installed the measuring apparatus, a circuit breaker, the interrupter of the three front lamps and an inverter permitting of running the vehicle backward.

A collector fixed under the carriage permits of putting the battery in charge by means of flexible wires connected with an electric source. The charge is effected by properly coupling the six groups according to the electromotive force at one's disposal.

The steering mechanism acts upon the fore-carriage, which is arranged like that of ordinary carriages, but is completed by an endless screw gear that is actuated by a hand wheel with a horizontal spindle, placed within reach of the coachman, through the intermedium of a pair of bevel wheels. Owing to this arrangement, the direction given by the fore-carriage is preserved indefinitely so long as the hand wheel is not touched, and this facilitates and assures the maneuver and permits of leaving the hand wheel to itself under many circumstances. The change of direction is effected by maneuvering the hand wheel, which obeys the least stress exerted upon its rim.

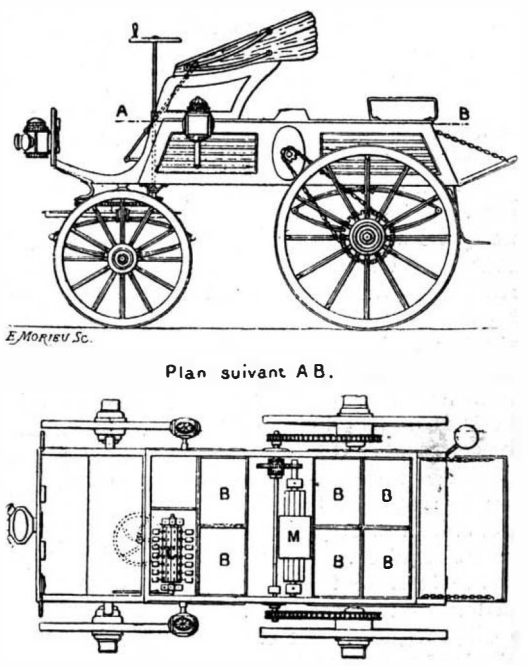
According to the data furnished us by Mr. Pouchain, the carriage in running order weighs 1,350 kilogrammes and is capable of seating six passengers. One charge of the battery permits of its making, upon a pavement in a medium state of repair, a trip of 70 kilometers at a mean speed of 16 kilometers per hour. A complete turn can be effected upon a width of street of less than four meters.

Upon a level, on an ordinary pavement, the normal speed naturally depends upon the number of accumulators mounted in series, the greatest speed (16 kilometers per hour) corresponding to the coupling of the six groups in tension. The other couplings give respectively speeds of 8, 6 and 3 kilometers per hour. In the last case, the six groups are in derivation and furnish 17 volts only. It is the mounting that corresponds to the starting that is ordinarily produced at 40 amperes (680 watts). In the ascent of a bridge covered with gravel, the current has risen to about 100 amperes without in any way being prejudicial to the accumulators, which, mounted in derivation, are capable of discharging 120 amperes normally.

The figure, reproduced from a photograph, shows that the electric carriage constructed by Mr. Pouchain is in no wise ungainly and presents even the advantage of being shorter than an ordinary carriage by the entire length of a horse—an interesting question from the standpoint of obstruction when, in a few years, the progress of accumulators aiding electric carriages and even electric coaches shall have come into general use. For central works of distribution of electric energy, this will prove an important outlet, of which we long ago pointed out the possibility and the practical future. The results already obtained demonstrate that our hope of twelve years ago was not chimerical, and prove that we are on the eve of its realization. Before the end of the century, Paris will have ceased to be the hell of horses in order to become the paradise of electric coaches.—*E. Hospitalier, in La Nature.*

AN IMPROVED VALVE GEAR.

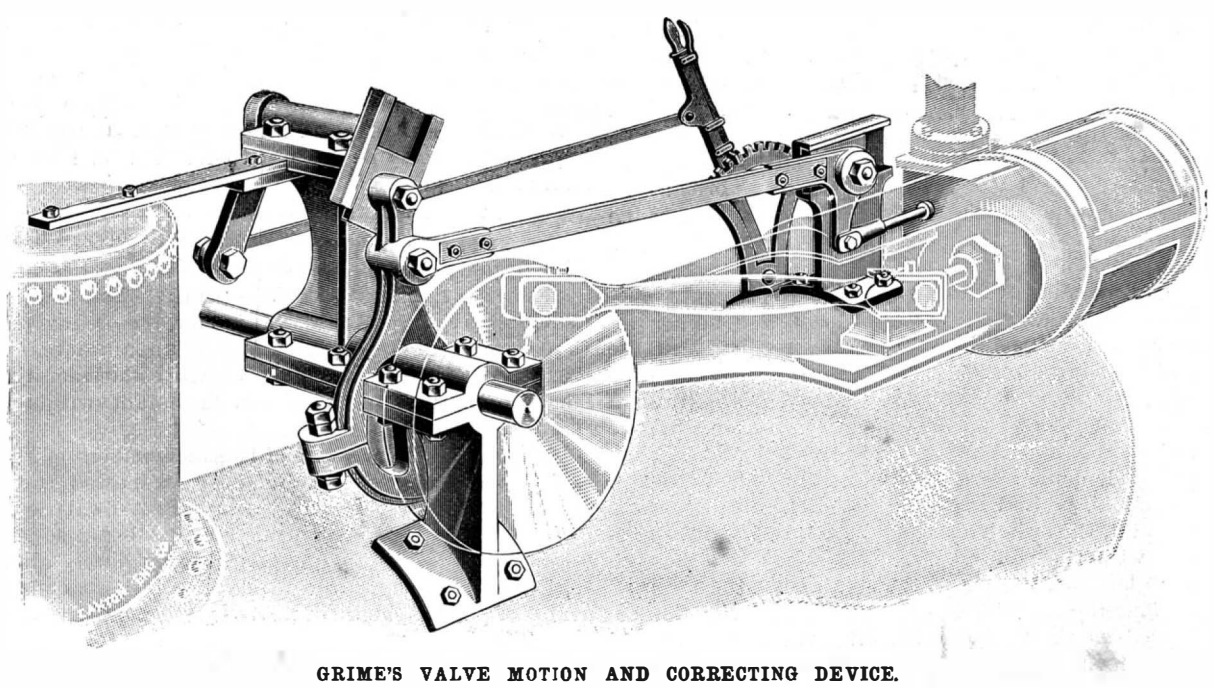
This gear is designed to facilitate the correction of errors arising from the movement or position of the eccentric and insure the proper running of the engine.



The invention consists principally of a connection between the eccentric rod and the valve stem, to correct the throw or travel of the eccentric by the angular movement of the eccentric at both the forward and backward stroke. The improvement has been patented by Mr. John Grime, of No. 1707 Seventh Street, South, Minneapolis, Minn.

In the cut is shown a standard, boxed upon the main axle and supporting a guide, or what some might term a link. In this guide slides back and forth a cast iron block; a little below this is seen the connection to rod that drives the valve. By throwing the guide over on an angle, the engine will run in either direction. The intermediate points between perpendicular and angle of thirty degrees are the various points of cut-off. The standard is shown braced to the dome, but it can be attached in several ways. The sliding block is a piece of cast iron about two inches square and four inches long, excluding the oil cup. It has a hole bored for pin and is finished on its working surfaces.

It will be noticed that the end of the eccentric strap is connected to the block with a pin, upon which it oscillates, and also drives block up and down in the slot or recess. The total oscillation is about one-tenth of a revolution, so that the friction due to oscillation is very slight. The surfaces on the sliding block are between eight and sixteen inches in area, so that the pressure of valve is distributed over a great area. The guide or link is of cast iron, simply a slot with a round shank attached. There is a gib, which can be used on one side if deemed necessary, so that all wear can be at any time taken up. It is so made that it is impossible for any one to tighten it, and may be slackened for insertion of paper liners. Eccentric strap is of the usual kind, with the exception that there is an extension with two holes for pins.



GRIME'S VALVE MOTION AND CORRECTING DEVICE.

The new correcting device serves to equalize the cut-off. The device is shown as an extension on the end of eccentric rod projecting downward and engaging and operating valve stem. It is of the nature of a cast iron bell crank, with a recess or socket for the insertion of a flat rod. The strain or pressure of valve is not transferred through any rocker bearing; one point only, and that is where attachment is made to valve

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stem, receives the pressure. The upper pin cast solid with slide receives but a very slight wear, as it only has to resist the up and down pressure due to angle of rod, and simply has the weight of the slide to pull back and forth. The oscillation of the lower point is very small, an average of about three-eighths of an inch. This correcting device may be attached to any engine or valve motion.

ALL MAY HAVE TELEPHONES.

(*Continued from first page.*)

rection. The space in the center of the magnet between the pole piece and distance piece is filled with a strip, *g*, of wood.

The cylindrical end of the distance piece which extends beyond the magnet is bored and tapped to receive the screw by which the magnet is held in place in the handle. The cylindrical projecting end of the pole piece extends to within 1-100 or 2-100 of an inch of the diaphragm. In other words, it is placed as near the diaphragm as possible without being touched by the diaphragm when the latter vibrates.

On the pole piece, *c*, is placed a wooden spool, *e*, on which is wound No. 34 (Am. W. G.) silk-covered copper wire. The wire fills the spool, and its ends are allowed to project one or two inches. The wire may be wound on the spool in either direction, and it is immaterial which pole of the compound magnet adjoins the diaphragm.

The resistance of the winding varies from 70 ohms as a minimum to 200 as a maximum. When the instrument is to be used both as transmitter and receiver, and especially when it is on long lines, the resistance should be 100 ohms or more. No. 36 wire is used for the winding where the resistance is great. Of No. 34 wire, 263 feet will be required for 70 ohms resistance. For 100 ohms, 373 feet are required. For 150 ohms, 343 feet of No. 36 are required.

In the end of the handle are inserted two binding posts to which are attached insulated wires (No. 18), which extend toward the diaphragm, their free ends being soldered to the terminals of the fine wire on the spool, so that when the telephone is connected up in circuit with other telephones the current will pass from one of the binding posts through one of the coarse wires, through the fine wire coil, through the other coarse wire to the other binding post.

The Bell telephone has a disk of flexible rubber slipped over the pole piece and over the ends of the coarse wires as a guard against short circuiting. A screw eye is inserted in the end of the telephone handle for suspending the instrument when not in use.

This telephone, when used in the manner suggested, requires neither battery nor induction coil. It is therefore easily connected up for use by electrically connecting the binding posts of one instrument with the binding posts of another. When a number of telephones are connected in the same line, the matter is not quite so simple. There are many ways of arranging the circuit; we give diagrams of two, one for one line wire with ground connections, the other for a metallic circuit, with a separate circuit for calling.

In the single wire circuit each instrument on the line is provided with a double switch cut into the line as shown in Fig. 2, the pivots of the switch arm, *a a'*, being connected with the line wire. The switch arms are pivotally connected with a bar of insulating material, so that they will move together. The arms, *a a'*, may be brought into contact with the points, *d d'*, *e e'*, and *f*. A magneto call box is connected with the points, *d d'*, and the arms, *a a'*, are left normally on these points, as shown in dotted lines, so that when any magneto in the line is operated the others will ring. All on the circuit have a special call.

The one called will know whether the signal comes from the east, west, north, or south. Suppose it to come from the east, the switch is placed in the position shown in full lines. This cuts out the magnetos, grounds the western section of the line through the point, *e*, and connects the eastern section with one end of the telephone cord through the point, *e'*, the other telephone connection being grounded through the points, *f e*, and ground wire. If the call is from the west, the switch arms, *a a'*, are brought into contact with the points, *e' f*. The arms, *a a'*, are always left on the points, *d d'*. Outside the terminal stations the line is connected with the ground or arranged as shown in Fig. 3, with the line grounded through the magneto or telephone.

In the metallic circuit shown in Fig. 4, the terminal telephones are connected with the ends of the line wires. Intermediate telephones are cut into the line by means of a double switch, as shown in the cut, in which *g* shows the intermediate telephone cut out, *h* shows it connected with the east and *i* with the west.

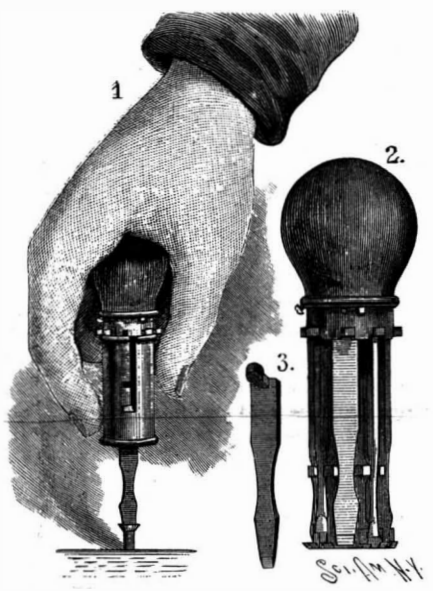
A third wire grounded at the ends, and including a magneto for each telephone, runs parallel with the metallic circuit. In this case all of the bells ring at once, and individual signals must be agreed upon.

It is obvious that the information here given in regard to the construction of the telephone may be departed from in minor points, such as the construction of the handle and mouthpiece, but everything relating to the magnet, the coil, and the relation of the magnet and diaphragm, should be strictly followed.

In a following issue we will publish a full description of a magneto call for use in connection with telephone lines.

A TOOL HOLDER WITH A VARIETY OF TOOLS.

This holder, patented by Mr. Henry Shogren, is arranged to carry a number of tools, such as screwdrivers, awls, small chisels, etc., each of which may be readily projected from the handle in position for use, as shown in Fig. 1. The tools are supported by a central cylinder having a split lower end and outer annular flanges with registering slots, each tool being guided in two of these slots, and the tools being held in place on the central cylinder by an exterior cylindrical shell, which has a lengthwise slot with side notches. The slot and the notches are engaged by a lug on each of the tools, as shown in Fig. 3, Fig. 2 showing the position of the tools with the shell removed. The upper end of the slot registers with one of a series of notches in a ring turning loosely in the upper end of the cylinder, each of the notches receiving the lug of the corresponding tool when the several tools are in their innermost position. In the top of the ring turns the lower end of a handle, centrally in the top of which is a nut, in which screws the threaded end of a bolt extending down centrally through the tool, the ring engaging and turning the bolt, and there being on the lower end of the bolt a conical head fitting a correspondingly shaped recess in the split lower end of the inner cylinder. By the turning of the ring the tools are moved around in the shell, whereby any desired tool may be brought into position to be projected from the handle,



SHOGREN'S TOOL HOLDER.

the lug of the tool then registering with the vertical slot in the shell, when the tool may be pushed out, and the knob on the lug made to engage one of the side notches. The operator, by then holding the shell and turning the handle, screws up the central bolt, and causes its conical head to expand the split lower end of the tool-holding cylinder, bringing its flange to bear upon the shell, and locking the cylinder and the several tools in place. Further information relative to this improvement may be obtained of Mr. N. J. Blagen, Portland, Oregon.

A New Antidote for Morphine.

Dr. William Moor, a specialist on therapeutics, and a member of the staff of the West Side German Clinic, in West Forty-second Street, this city, has discovered that permanganate of potassium is an antidote for morphine poisoning, and that it will counteract the effects of any of the alkaloids of opium within a reasonable lapse of time.

Dr. Moor, in the presence of twelve members of the clinic who assembled on January 9, swallowed three grains of morphine, which is ordinarily a fatal dose, and a positively fatal one in his case, as he is supersensitive to the effect of narcotics. Immediately after taking the morphine, he drank a solution of four grains of permanganate of potassium in four ounces of water.

The physicians had Dr. Moor under their eyes for five hours after the experiment, but, as far as they could discover by every sort of test, he might as well have swallowed the water alone. The antidote had done its work well, for the effect of the morphine had been entirely neutralized.

It has long been known that the new antidote is a destroyer of organic matter. The reason that it has not been used until now as an antidote for morphine is that it has generally been regarded as certain to be deoxidized and thus rendered powerless by contact with the organic matter of the stomach. But Dr. Moor's discovery is that the permanganate will select a soluble salt of morphine from the albumen peptone and other contents of the stomach with astonishing rapidity. It will, in fact, decompose a morphine salt several hundred times quicker than it will decompose albumen. The discovery of this property of selection of the permanganate's affinity for the morphine salt gave Dr. Moor his cue.

The antidote acts upon the poison at which it is aimed long before the other contents of the stomach have had time to destroy its antidotal powers.

In cases where preparations of opium other than the sulphate of morphine have been taken internally, Dr. Moor has found that the antidote should be acidulated with vinegar in the proportion of one to five, and then it proves efficacious at once.

The lapse of an hour or two will not, it is thought, make the new antidote useless, though the counteraction must necessarily be slower and less satisfactory in such cases.

Fortunately, opium and its alkaloids are slow poisons, and death seldom ensues for some hours. It is this that leads to the hope that the scope of the new discovery may be far greater than can as yet be seen. Of its importance in the treatment of the morphine and opium habits, it is too early to speak authoritatively, but, if Dr. Moor's opinion is correct, its usefulness in this direction will prove incalculable.

Aluminum Boron Bronze.

Mr. H. N. Warren, of Liverpool, England, has been experimenting lately with aluminum bronzes, and has found that the presence of a very small admixture of boron makes a denser and more durable alloy. This aluminum boron bronze casts and melts well, and is free from some drawbacks met with in working with the ordinary aluminum bronze. Producers of that alloy often complain of the difficulty experienced in obtaining a uniform mixture; for a difficultly fusible alloy sometimes forms on the surface of the molten portion, and being accompanied by surface oxidation, refuses to alloy with the remainder. The aluminum boron alloy forms at a lower temperature than when pure aluminum is used. In preparing this bronze Mr. Warren first makes ingots of aluminum containing boron in the same state in which graphite exists in cast iron. These ingots are made by introducing aluminum into a molten mixture of fluorspar and vitrified boric anhydride, which has been heated in an oxy-hydrogen furnace until fumes of boron fluoride appear. The boron is immediately reduced and it dissolves in the aluminum, and the aluminum is rendered crystalline and brittle thereby. When added to copper in the proportion of 5 to 10 per cent, it forms the aluminum boron bronze in question, which is not brittle. The effect of boron on this bronze would appear to be quite different from that of silicon, which generally ruins all bronzes when present even in minute quantities.

Novel Barometer.

A description appears in the *Rivista Scientifica Industriale* of a new barometer of high sensibility and of special service in coal mines. The apparatus consists of a vertical tube twenty mm. in interior diameter and about one m. in length, the bottom of which is curved in the ordinary manner—the opening at the top, however, being furnished with a steel peg screwed in an iron collar attached to the tube. A long capillary tube, one mm. in diameter, is fixed at right angles on the large tube, a little above the curved part, and terminating in an open receptacle.

The quantity of mercury is regulated so that the meniscus of mercury presents itself in the middle of the capillary tube. The slightest difference of atmospheric pressure will cause the mercury to rise and act on the capillary column, and a fall of pressure is indicated by the inverse movement of the column. In this way the increase or decrease of the mercury in the large tube is augmented according to the section of the tubes, and in this case as 400 is to one, so that a variation of 1-400 of a millimeter can thus be noted. If the variation in pressure become great enough to cause the meniscus to leave the capillary tube, that may be remedied by screwing or unscrewing the upper peg.

In a paper recently read before the American Society of Civil Engineers, by Mr. James D. Schuyler, M. Am. Soc. C.E., the author stated that 16 miles of 30 inch wooden conduit have been used in the water supply of Denver, Col., and there was a considerable length of 44 inch wooden pipe. The timber used was Californian redwood, and the 30 inch pipe was built for a head of 185 feet. It cost about 5s. 8d. per lineal foot as laid; the laying and trenching account for 2s. of this amount. The pipes in question were composed of staves, dressed very smooth to cylindrical sides and radial edges, and were held to form by hoops of mild steel placed 17 inches or less apart, depending on the head. The pipe was framed in the trench, and all handling of full size sections avoided. The use of these wooden pipes is claimed to have resulted in a saving of about 200,000*l.*

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Correspondence.

The Cost of Sodium.

To the Editor of the Scientific American:

An article on the subject of alkali metals, in your issue of December 30, mentions the present price of sodium as being $1.75 per pound. This is an error and I think should be prominently corrected, particularly as special reference is made to this price and special causes which are said to have contributed to advancing the price from a lower previous figure. The Aluminum Company of England, with whom I am connected as managing director, are now the only firm engaged in the manufacture of sodium. The present general market price of the metal is 75 cents per pound, but under special conditions as to quantity and for particular purposes or uses it is being sold at very much lower prices. As the article referred to is particularly misleading in reference to the important question of price, I trust, as it is a matter also of serious interest to the present manufacturers, you will make proper and prominent correction.

Any further information on the subject I shall be pleased if possible to afford. H. Y. CASTNER.

Homosassa, Citrus Co., Florida.

Relief for Stranded Vessels.

To the Editor of the Scientific American:

Noting in the SCIENTIFIC AMERICAN an article on the difficulty of getting a line to or ashore from a stranded vessel, would say I have done considerable wrecking while on the lakes. As to my success while there for over thirty years, that is for others to say. During that time I had a number of occasions to send a line ashore. We then called it a running line. After trying buoys, boards, rafts, etc., I adopted the plan of a barrel, with a reel inside, leaded inside on the corner, and a grapple on the outside in the shape of a one-fluked anchor that was to catch on to prevent the surf from carrying the barrel back when it struck shoal water. The lead I put in heavy enough to keep the barrel partially on end, and on the bottom and side of the barrel that the grapple is attached to. The device is so cheap and simple that any sailor can make one for his vessel with little cost, and it may be relied on to help him out of a bad mess.

W. H. LITTLETON.

[Our correspondent's device is a practical one, and since his first use thereof it has come to be known among seamen, but is not as much used as it ought to be. In our SUPPLEMENT, Nos. 852 and 854, engravings of it appeared.]

Japanese Prisons and Convict Settlements.

BY REV. W. W. CURTIS, OF SENDAI.

An experiment is being tried in the great northern island of this empire which ought to enlist the sympathies of all Christendom. The people of Japan have not yet opened their eyes to what is going on within their borders, but the experiment, which is nothing less than an attempt to administer the great government prisons of the Hokkaido according to Christian principles, is being made with the full approval of the central government, who take deep interest in it, and seem to expect that it will result in a reformation in the treatment of prisoners throughout the land.

Fourteen years ago the government began the practice of sending long-sentence convicts to the wilds of the Hokkaido, which they were trying to colonize, intending to utilize these convicts in preparing the way for the coming of settlers. Now there are four great prisons, two in the west, in the Ishikari valley, a region rapidly being settled, and in which is Sapporo, the capital of the Hokkaido, and two in the east, one on the Okhotsk Sea, the other some sixty-five miles inland.

A fifth prison is soon to be opened in the fertile Tokachi valley, in the southern part of the island. In these four prisons are some 7,000 men, employed for the most part in cutting down the forests and reclaiming land, in roadmaking, and in mining. Into the regions which they have opened in the forests settlers are flocking by the hundreds yearly. The product of their labor in the coal mines is finding its way by the million tons to America. No convicts are sent to the Hokkaido under a shorter sentence than twelve years, the periods ranging from this to life service, so that scarcely any have been discharged as yet; but within the next two years some 1,900 will gain their freedom. The result of turning loose so many criminals in that thinly populated region is looked forward to with anxiety by the settlers.

A few years ago these prisons were entirely independent of each other, and in some of them the government was quite lax. Two years since they were all put under one management, and the most efficient of the wardens, Mr. Oinue, was made general superintendent, in addition to the duty of being warden of one of the prisons. Mr. Oinue is a man of great executive ability, ranking highest in this respect, I have heard, of all the wardens in Japan. Very strict in the execution of the prison rules, he at the same time shows so kind a heart that he is both feared and liked by the prisoners and most thoroughly respected by everybody. He consults freely and intimately with the other wardens and with the moral instructors, so that whatever is attempted is sure of having sympathetic support in all the prisons. His superior insight led him to the conviction years ago that the principles of Christianity are what are needed for the instruction of the prisoners, and he was anxious to get a Christian instructor for the prison of which he then had charge. Succeeding in this, and his anticipations being fully realized, when he was subsequently transferred to another prison he soon secured a Christian instructor for that; afterward, when made superintendent of all, he went to the third prison, the oldest of all, and introduced a Christian teacher there, and to the fourth prison, which was just opened, he sent as warden the man who had been next to him in authority in his first prison, and who also had become convinced that the new religion was the right one for the instruction of criminals; so to that prison a Christian teacher was appointed from the start.

In my tours in the Hokkaido it has been my privilege to visit all of these prisons and to inspect them thoroughly; some of them in two successive years.

My first visit was to the chief prison. When the instructor requested the privilege of showing the prison to his friend he was refused permission, on the ground that it is against the rules of the Prison Department to admit strangers. But subsequently learning that I was a Christian missionary, Superintendent Oinue not only waived the rule, but in person showed me over the whole institution. I was greatly pleased at the evidences I saw in all of the prisons that officers and guards discharge their duties, not perfunctorily, but with an interest in the welfare of their prisoners. Spending weeks in the neighborhood of these prisons, I saw the convicts in many places, both within and without prison walls, and saw them under various circumstances, yet not once did I see the abuse that I have seen in other parts of the country. The system of management seems well calculated to develop manhood, and to make the men capable of earning their living as good citizens when released.

The greater part of the men are engaged, as has been said, in public works, but each prison has its farm and its series of workshops, in which are carried on such industries as are needful in their self-support, yet none of these are carried to such an extent as to compete with free labor by throwing the products of prison labor into the market. The workshops in these great prisons are interesting sights. In them are carried on carpentering, blacksmithing, coopering, tailoring, shoemaking, harness and saddle making, toolmaking, etc. Rice cleaning is an important industry in Japan, and each prison has its rice cleaning and also its *shoyu* and *miso* department. These sauces, shoyu and miso, made of beans, wheat, and salt, are almost as essential to a Japanese meal and in cooking as pepper and salt are with us. The rations served are abundant and wholesome, and a principal article of diet is rice and wheat mixed in the proportion of six parts to four, more nourishing than the clear rice, which is the usual food of the better classes in the land.

The washhouse, the cookhouse, the bathhouse, the changehouse, where garments are changed as they go out to work and again as they return, the dryhouse, where their workclothes if wet are quickly dried, and the hospital all show thorough provision for the bodily wants of the men.

The cells are well ventilated, clean and neat. In almost every one is to be seen a little pile of books, scientific, ethical, and religious, showing not only the privilege granted them, but that the men, as a rule, are glad to avail themselves of it. A noticeable feature in each cell is the handwriting on the wall. A "golden saying" hangs there, the words of some wise man, Confucius, Mencius, or other ancient or modern sage, among them quotations from the Bible. These aphorisms, selected by the warden or the instructor, look the men in the face as they enter their cells day by day until they are thoroughly familiar, then are replaced by new ones.

More interesting than the workshops and cells are two rooms, one for personal conversation, where the instructor summons individuals with whom he wishes to talk privately and where they may seek an interview with him if they choose, and the room where is kept the record of work and behavior. The conduct of each prisoner is recorded every day in regard to three particulars: (1) Observance of the rules, (2) deportment toward the guards and toward other prisoners, and (3) diligence in work. If well behaved, they are granted special favors, and are paid a small amount monthly, being permitted with the money to make purchases. They receive rewards of merit in the shape of blue squares on the coatsleeve. I have seen a good many in the shops with one, two, three, four, and even five of these marks of honor, the latter showing them to be worthy of great trust.

Each prison has its chapel, or lecture hall, where the prisoners are assembled every Sunday afternoon for a moral address, after which is held a Sunday school. Attendance at the lecture is compulsory, at the Sunday school optional. I imagine that such unique Sunday schools are to be found nowhere else in the world, where, side by side, are classes in Bible study and classes in the Buddhist scriptures and the Confucian classics. Here may be seen zealous Buddhists and Confucianists, stimulated in the study of their own religions by the interest of their fellow-prisoners in the Christian religion. However, the study of the Bible, wherein are found the wonderful, new doctrines of the fatherhood of God and the brotherhood of man and of a present salvation from sin, proves by far the greater attraction.

There are many inquirers about Christianity in each of the prisons. Out of 1,506 prisoners in the Kabato prison, where Christian instruction was begun latest of all, 510 are studying the Bible, and of these 148 pray daily and follow the course of daily Bible readings marked out by the *Seisho no Tomo* (Bible Friend), a course used quite generally by the Christians of Japan. There is no chance while in prison for a public confession of Christ, as by joining the church, but the radical change wrought in the character of some of the men is such as greatly to impress those who have witnessed it. According to the testimony of their teachers, they are "an example to believers."

The results of Christian instruction have not yet attracted public attention to any extent, so few have as yet been released, but these results are beginning to be manifest in the prisons, not merely in the conversion of some, but by a general leavening. In evidence of this, the little effort made of late to escape from prison may be compared with that of a few years ago. From the beginning of the present year up to the latter part of May, when I last visited the prisons, but one man out of all the 7,000 prisoners had escaped. Last year the number of fugitives was 70; the year before it was 160; the year before that a still greater number. For this improvement two reasons were given me: one that the prisoners are beginning to believe that they can depend on the Christians to befriend them when they are discharged; the other, that the guards in all of the prisons are becoming interested in the good conduct of the prisoners, and are doing their best, so that a generous rivalry has arisen as to which of the prisons can make the best showing.

The general tone in all the prisons has greatly changed under Christian influence.

One thing that has given the prisoners great hope is the organization of an "Association for the Protection of Discharged Prisoners." A large tract of land was selected not far from Kabato, on the Ishikari River, the largest river in Japan, where it was planned to found what they call a Puritan colony of these discharged men, having as the ideal of this colony that simplicity of life and uprightness of character which marked the early New England colonies. A schoolhouse and a church are to be the first buildings. Buddhist opposition of late has put obstacles in the way of their getting a title to the land, and it is yet uncertain whether they will be able to carry out their plans just as designed. Another thing that has been very helpful is a prison magazine, called *The Sympathy*, which has quite a circulation in the prisons. Many of the prisoners, as I understand, subscribe for it. It is an independent undertaking of the instructors, having no government aid in its maintenance.

The way in which this great experiment in the Hokkaido came to be attempted, the providential leadings in it from the first until now, are of deep interest. But the account must be reserved for another paper.—*Missionary Herald.*

Production of Colors in Glass.

According to *Die Glashutte*, the beautiful coloring of certain varieties of glass now produced in Germany, and which far excels some of the most noted French specimens, is an art practiced by the glassblowers at the furnace, by means of an apparatus consisting of a sheet iron cylinder, 20 inches long and 8 inches diameter, standing vertically, and having a similar cylinder riveted across the top, thus forming a T-shaped muffle. In the lower cylinder is an opening into which an iron ladle can pass; and the horizontal cylinder is provided with doors at either end, the one nearest the operator being so arranged that the blowpipes can be supported when the door is closed in a horizontal split running to its middle, the object to be treated being held inside. While the glassblower is reheating his work for the last time in the furnace an attendant takes the long-handled iron ladle, which has been heated red hot, shakes into it about a spoonful of a specially prepared chemical mixture, and places the bowl of the ladle quickly in the opening provided for it in the vertical cylinder. The mixture immediately gives off vapor, which rises to the horizontal cylinders, where, meanwhile, the blower has placed his work, supported by the blowpipe, and heated to an even red, turning it rapidly in the vapor; in a short time the object is covered with a changeable luster, is removed from the pipe and tempered like other ware in an ordinary oven, then cut, engraved, painted, or gilded, as desired.

NATURALISTS assert that a healthy swallow will devour 6,000 flies every day.

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[FROM THE SCIENTIFIC AMERICAN of June 5, 1880.]

EDISON'S NEW ELECTRICAL RAILWAY.

But for the chronic aptitude of this generation never to wonder at anything, we might expect to witness expressions of surprise as it becomes known that we are to be whisked through the country at the rate of thirty, forty, or fifty miles an hour by an agent invisible and unknown save by its effects; but the moment electricity is suggested as a motive power for railways, the never to be surprised public say, "Why not?" Nevertheless, the practical application of the electric current to this purpose seems never to have had a prospect of success before the experiments of Dr. Siemens, in Berlin, in 1879, and the present extended experiments of Mr. Edison. It is a subject fraught with difficulties, and while it has always offered a seemingly promising field for inventors, the expense attending experiments of this class has been a most effectual barrier to progress.

Mr. Edison, more fortunate in this respect than many of our experimenters, has not been hampered by monetary difficulties, and having had ample means for carrying out his ideas in practice, he has been enabled to develop his inventions more rapidly perhaps than any other man living.

His new electric railway at Menlo Park is built over natural ground, with little or no grading, and with no regard for curves or grades. It is at present something over half a mile long, and is soon to be extended to form a mile circle. The present rolling stock consists of one electric locomotive and one open car. The general appearance of the railway and its equipments will be seen in our engraving. The motor is precisely like one of Mr. Edison's electrical generators, figured and described in our columns some time since, and the motive power is supplied by his stationary engine, the power being converted into electrical energy by a single generator.

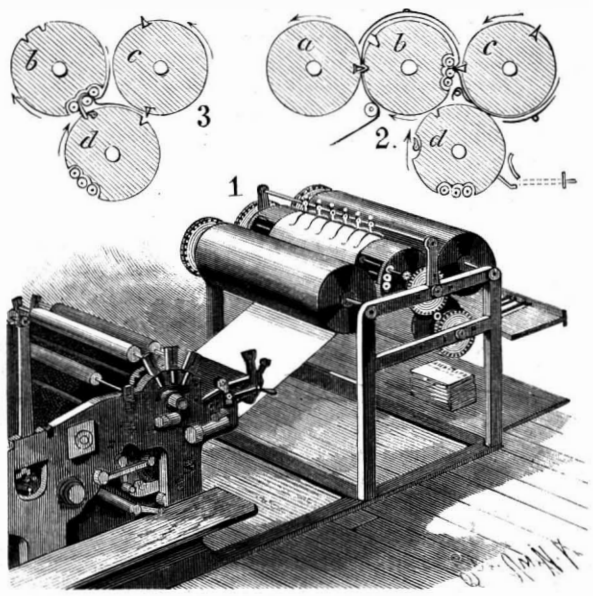
The current thus created is conveyed to the track by two copper wires, one wire being connected with each rail. The armature of the locomotive makes four revolutions to one of the drive wheels. The machine is managed about like a steam locomotive, and it pushes ahead with wonderful energy.

By invitation of Mr. Edison, representatives of this journal were present at a recent trial of this novel motor, and had the pleasure of riding, with some twelve or fourteen other passengers, at a breakneck rate up and down the grades, around sharp curves, over humps and bumps, at the rate of twenty-five to thirty miles an hour. Our experiences were sufficient to enable us to see the desirableness of a little smoother road, and to convince us that there was no lack of power in the machine. Mr. Edison says that he realizes in the locomotive seventy per cent of the power applied to the generator. He will soon add four more cars, and apply improvements which he has in contemplation.

This grand experiment is designed to test the applicability of the electric current to this purpose and to develop a railway system suitable for plantations, large farms, and for mining districts, and perhaps it is not entirely visionary to expect that our street and elevated railways may at no very distant day be successfully operated by electricity.

A ROTARY NEWSPAPER FOLDER.

This is a very simple machine, adapted to fold papers as they come from any kind of a press in a continuous

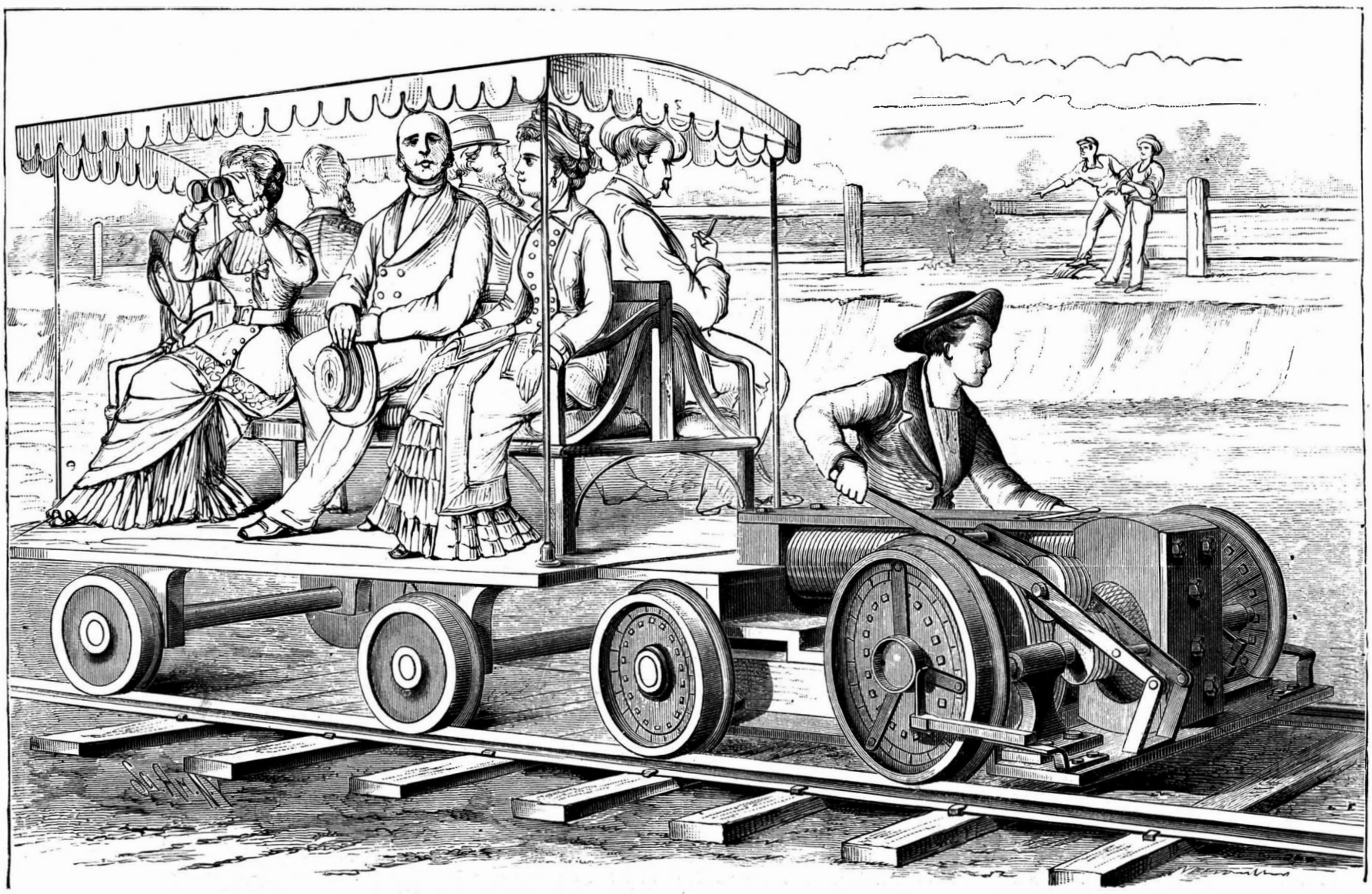


CARR'S ROTARY NEWSPAPER FOLDER.

web, cutting the sheets the correct size, and without employing knives which move in relation to the cylinders. The improvement has been patented by Mr. E. W. Carr, of No. 110 Fifth Avenue (room 3), Chicago, Ill. Fig. 1 shows the machine in position at one end of a press, Fig. 2 representing the folding cylinders with the web being cut and the position of the severed sheet as the first fold is being made, and Fig. 3 showing the sheet while the first fold is being rolled down and the sheet carried forward. Cylinder *a* serves in connection with cylinder *b* as a cutting cylinder, while cylinders *b*, *c*, and *d* serve as folding cylinders, there being in the first cylinder a fixed knife which registers with a groove in the second cylinder, so that at each revolution of these two cylinders the web will be severed, the size and speed of the cylinders being such that the sheet will be cut the proper size. In a recess in the face of cylinder *b*, opposite the knife registering groove, is a series of parallel folding rollers, between which the paper is forced by a folding blade in cylinder *c*, making the first fold, after which the paper is engaged by grippers on cylinder *d*, there being also in this cylinder folding rollers between which the paper is forced to make the second fold by means of a second blade in cylinder *c*. On the back side of the lower and last roller is a chute into which the paper is delivered after being twice folded, being carried forward against an abutment and supported on the usual parallel rods until pushed down between them to make the final fold in the usual manner. The folding rollers are preferably turned by a gear mechanism, and above cylinder *b* are curved finger rods to prevent the paper from rising, while above cylinder *d* is a spring guide pressing the paper against cylinder *c*, the several guiding devices holding the web snugly against the faces of the cylinders.

Pneumatic Wheels.

It is not a great while since pneumatic tires were introduced with the view of giving a maximum amount of elasticity to wheels. These were succeeded by wheels having pneumatic hubs, or naves, of which there have been at least three brought out within the last few months. The next step is to make the whole wheel pneumatic, and this is now done in the wheels made by the Pneumatic Wheel Company, of London. The new wheel consists of a flattened spherical chamber filled with compressed air. The outer shell is made of a material which is slightly yielding in itself, but exceedingly tough, so that it is with difficulty broken or cut into. Inside is an India rubber chamber conforming to the shape of the shell, which is inflated from outside the wheel with air under pressure. A pair of metallic plates are affixed to the wheel, one on either side, there being an open tube connecting the plates and passing through the center of the wheel. The axle passes through this tube, and is secured to the wheel. There is a small valve in the side of the wheel connected with the air chamber, so that the wheel can be deflated at any time, or if deflated by long use or other cause it can be readily inflated. A dog-cart mounted on a pair of these wheels, but having also a pair of light springs, was the vehicle by which the pneumatic system was tried. The wheels are 26½ inches diameter by 5¼ inches broad. The vehicle ran very lightly, the crossing of tram rails at right angles being scarcely perceptible, while granite pitched roads were as quietly and as smoothly traversed as those of well leveled macadam. The company are adapting these wheels to cycles and horse vehicles, and are about to supply them to an electrical omnibus shortly to be run. These wheels will be 31 inches diameter by 11 inches thick, and 26 inches diameter by 6¼ inches thick when inflated.



EDISON'S ELECTRICAL RAILWAY.

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AN ELECTRIC MOUNTAIN RAILROAD.

The Mount Lowe Railway, in Southern California, is a remarkable achievement in mountain railroad building, both as regards the engineering difficulties overcome and the unique motor equipment of the road. Its purpose is to connect Pasadena, a beautiful and famous residence city near Los Angeles, with the summit of the Sierra Madre Mountains, nine miles distant and 6,000 feet above sea level.

The mountain road starts from Altadena, a point twelve miles from Los Angeles and three miles from Pasadena, at the terminus of a local steam railway which ascends the foothill mesa of the mountains to an altitude of 1,500 feet. The first two and a half miles of the Mount Lowe Railway is an electric trolley road, and climbs up the remainder of the mesa for a mile and a half, and then penetrates Rubio Canyon, a deep and romantic gorge, for another mile, much of this part of the road being terraced out of the side of the granite mountain, and conforming to the sharp curves of its lateral indentations.

The trolley terminates at Rubio Hotel and Pavilion, a unique structure built across the canyon at an altitude of 2,200 feet, being somewhat higher than the summit of the Alleghanies where they cross the State of Pennsylvania. Beyond the hotel the canyon narrows to a deep, tortuous gorge, or crooked chasm, with lofty walls of gneiss, richly striated with hornblende and feldspar. Terraced walks, bridges and stairways furnish access to a succession of beautiful waterfalls and other bits of wild and romantic scenery.

From Rubio Hotel, a double track, three rail, endless cable incline, 3,000 feet in length, lifts the passenger to the summit of Echo Mountain, 3,500 feet above the sea, overcoming in eight minutes an altitude of 1,300 feet, and passing over a varying gradient which ranges from 48 to 62 per cent.

Two cars of peculiar construction are provided with transverse seats arranged in three compartments, rising above each other like steps. These cars are permanently fastened to the cable, and one ascends as the other descends, passing each other at an ingenious automatic turnout in the center of the incline, 1,500 feet from either end. Like the trolley road below, this road is operated by electricity, and is said to be the only cable incline in the world operated by electrical power. The winding machinery and motor are located in a motor house on Echo Mountain, the entire plant having been designed and constructed by A. S. Hallidie, of San Francisco, builder of the first street cable railway ever operated.

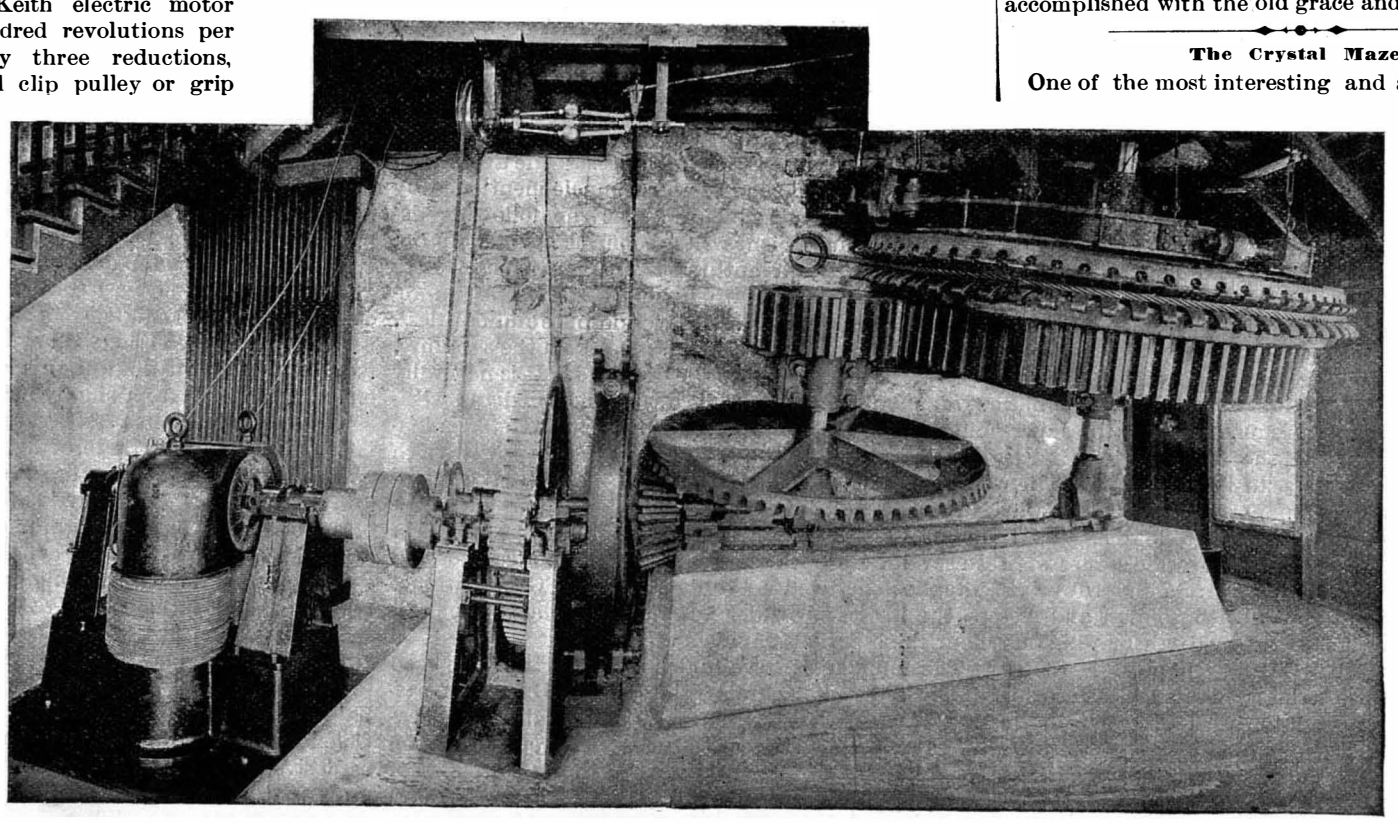
The one and a half inch cable is driven by a seventy-five horse power Keith electric motor making eight hundred revolutions per minute, which, by three reductions, drives a horizontal clip pulley or grip sheave of the Hallidie type, making seventeen revolutions per minute. This grip sheave is provided with movable automatic jaws and with a band brake. The conductor of the incline car can signal the engineer at the motor house at any point on the incline and stop the car or proceed at will.

The dynamo which furnishes the current for the entire system is an Edison bipolar generator, manufactured by the General Electric Company, and is located in the company's power house at the Altadena station, and driven by two sixty horse power Otto gas engines, the gas being economically manufactured on the premises.

An eight inch pipe will soon be conveying an ample stream of water with a 1,400 foot head to a power house a mile below the hotel, and two large Pelton wheels will drive the dynamo at a nominal cost, represented by interest on cost of plant, wear of machinery and superintendence of works.

While this great dynamo furnishes power for the trolley road and cable incline, another supplies the electric current for an elaborate system of arc and incandescent lights to illuminate the hotels, canyon and adjacent grounds. The arc lights stationed along the steep incline, high above the foothills, form a striking object of interest at night as they gleam out from the mountainside and throw their bright rays far over the landscape, and are particularly noticed by passengers in the overland trains threading their way through the distant valley after dark.

THE GREAT CABLE INCLINE, MT. LOWE RAILWAY, CALIFORNIA.



THE CABLE WINDING MACHINERY, MT. LOWE RAILWAY.

The view from Echo Mountain facing the south is one of unsurpassed loveliness. It embraces the broad San Gabriel Valley, with its cities, hamlets, orange groves and cultivated fields, bordered on the east by a serrated horizon of mountain peaks, and on the south and west by a large segment of the Pacific Ocean, dotted along sixty miles of coast with pearly islands.

Excellent bridle roads, now leading from Echo Mountain to the summit of Mount Lowe, 6,000 feet above sea level, will be superseded by an electric trolley road, for which a suitable grade has been surveyed.

Professor T. S. C. Lowe, projector, builder and president of this mountain road, has distinguished himself in other fields of science, having invented the system of water gas now in general use for gas illumination. Professor Lowe was also the first to produce artificial ice on a commercial scale. For these, and other inventions useful to humanity, he has received from the Franklin Institute, of Philadelphia, three medals and a diploma, the highest award ever given to one man by that institution.

Professor Lowe now proposes to round out his series of honorable achievements by establishing upon the summit of the Sierra Madre range which has received his name, an astronomical observatory, well equipped for doing the best photographic and spectroscopic work in that department of science. On account of the high altitude, the clear atmosphere and the southern latitude, important scientific results are anticipated by such distinguished astronomers as Professor Lewis Swift and Dr. E. E. Barnard.

Blondin the Rope Walker.

M. Blondin, now in his 71st year, is giving marvelous performances upon the high rope at the Crystal Palace, London. In 1861, he walked across the Niagara Falls on a rope 1,100 feet long, stretched at a height of 160 feet above the torrent. At the Crystal Palace his performance is upon a rope stretched across the center transept at a height of 60 feet from the ground. The rope, which is an inch and three-quarters in diameter, is made of steel wire, covered with six strands of manila, and from anchor to anchor it is 400 feet long. Blondin walks across the rope blindfolded, stands on his head, carries a man on his back, and performs other feats, all of which are accomplished with the old grace and daring.

The Crystal Maze.

One of the most interesting and amusing lessons in optics and reflections is to be found in the Crystal Maze, Broadway and 38th St., this city.

By a scientific arrangement of mirrors placed at angles calculated to the fraction of an inch, effects in reflection are produced which would have been deemed impossible. One reflection is again reflected, and so on to infinitum, until, like specters, the lost image disappears.

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[FROM THE POPULAR SCIENCE NEWS.]

The Ruby.

BY BENJ. F. MASON.

The true or oriental ruby is the gem of gems, and exceeds in value, when perfect, even the diamond. But to give it this great value its color must be of that peculiar shade of red called "pigeon's blood," which is a pure, deep, rich red, without a tinge of blue or yellow. And when of this deep, rich red the ruby is a magnificent and resplendent gem, which the ancients gave a heaven-born origin by a myth representing that it drops in blood-red crystals from the clouds amid the flashes of lightning.

In the language of gems the ruby is the emblem of elegance and beauty. By the ancients it was also considered to possess the power to correct evils resulting from mistaken friendship, and to reveal poison; and in the middle ages it was regarded as an amulet, protecting against the plague, sadness, evil thoughts, wicked spirits, ill health, danger and death.

The oriental ruby, the oriental sapphire, the oriental amethyst, the oriental emerald, and the oriental aquamarine are all corundum or pure alumina, having the same form of crystallization, like composition, and the same hardness. They are all, therefore, the same mineral, and difference in color is the only reason for changing its name, in calling the blue ruby a sapphire, the green ruby an emerald, and the purple ruby an amethyst.

The ruby is formed in rhombohedral crystals, usually imperfect. Though the cleavage is sometimes interrupted and imperfect, it is basal, that is, the crystal breaks across the prism with a flat surface. The luster of the gem is vitreous, and occasionally exhibits a bright opalescent star of six rays in the direction of the axis. It is very tough, when compact, and its colors vary from the lightest rose tint to the deepest carmine.

Its specific gravity is from 3·9 to 4·16, and its hardness is superior to any known substance except the diamond, being number nine in the scale, while the diamond, which stands at the head, is ten. It is transparent to translucent, and breaks with an uneven or conchoidal fracture. The composition of the ruby is alumina, colored by traces of metallic oxides, as the following analysis of a gem shows: Alumina, 98·5; oxide of iron, 1; lime, 0·5. The ruby is not acted upon by acids, and before the blowpipe remains unaltered, but with borax and salt of phosphorus dissolves slowly.

Rubies are usually found in association with sapphires, topazes, zircons, rutile, magnetic iron and gold. The crystals of the gem are sometimes found perfect, tapering at each end, but more often abraded or rounded; while frequently various colors in bands extend across the prism of the crystal, as when both ends of the crystal are white and the center red, or the reverse, or when any one of the colors is replaced by yellow, or even black. These gems are usually obtained from layers of earth or river beds and streams, near crystalline rocks, such as gneiss, mica, slate and granite. Rubies are found in Farther India, in the kingdom of Ava, in Siam, and in the Capelan Mountains, in Pegu. They also occur in Ceylon, at Hohenstein, on the Elbe, in the Rhine and Danube, in Australia, and in the rivers Auvergne and Iser, in Bohemia.

The ruby mines of Burma, from whence for ages the finest rubies have been obtained, are situated about seventy miles from Mandalay, and extend over an area of a hundred square miles. For centuries this district has been regarded by the natives with a reverence almost approaching veneration, and no stranger has ever been permitted to approach the mines where the precious stones are obtained. All that is known of them is that they are worked by sinking pits in the earth until the ruby-bearing stratum is reached, which varies in depth from two to twenty feet. These mines produce annually vast quantities of rubies and sapphires, besides oriental amethysts and topazes, together with chrysoberyls and spinel rubies. For centuries these mines were regarded as the special appanage of the crown, and one of the highest prized titles of the King of Burma was "Lord of the Rubies." Though the government did not work these mines, but leased them at a monthly rental, yet it reserved for the royal treasury all stones that were worth more than fifty dollars, thereby giving the king almost a monopoly of the ruby fields, for it is only very small rubies that are worth less than this sum. Though the superintendents closely watched the miners, many large stones were carried away by stealth, and again, when a ruby or a sapphire worth more than fifty dollars was discovered, the finder, in order to be able to retain the gem, broke it in twain, and thus many fine stones were ruined. When an unusually large and fine ruby was found, a procession of grandees with soldiers and elephants was sent to bring it to the royal treasury. When the late King Theebau wished to impress a visitor with his immense wealth, he conducted him into his treasury and permitted him to thrust his arm into the great jars of rubies and sapphires which stood in rows around the apartment. In this collection, the rarest and finest in the world, were many gems of almost priceless value. When Theebau abdicated the throne, he took with him many rare and beautiful gems, but most of the jars of rubies and sapphires were looted during the interregnum that followed the sovereign's departure. The rubies from Ceylon, though not found in as large quantities as those in Burma, are very fine, and are discovered in river beds and large streams.

The oriental or true ruby is often confounded with the spinel ruby, which is an inferior and entirely different gem, containing about twenty-eight per cent of magnesia. These stones are often sold through error, or with the intention to defraud, but the difference may be easily detected by the inferior hardness and lower specific gravity of the spinel ruby. This is particularly the case with Ceylon spinels. This is an old error, for in ancient times all red stones were called carbuncles and rubies, and even at the present time this name is applied indiscriminately to various red gems, which is very deceptive to the novice, who imagines the ruby to mean only the red corundum. Even the two large stones exhibited by Queen Victoria as rubies at the London Exhibition of 1862 were found on an examination of their specific gravity and hardness to be spinels.

In experimenting in the manufacture of rubies, chemists have succeeded in producing artificial crystals of the same form of crystallization and of equal hardness with the natural gem, but they were very small and of little value, being no larger than those used for watch jewels, which can be bought by the pound. The artificial rubies are formed by melting alumina and borax in a platinum crucible. The borax dissolves the alumina, after which it evaporates, leaving the alumina in a crystallized state. Blue and red crystals have also been produced by bringing the volatilized fluoride of aluminum into the vapor of boracic acid, when decomposition takes place, and fluoride of boron escaping, leaves the crystals of alumina.

In the United States rubies have been found in association with sapphires at Vernon, N. J., but they were generally opaque and unfit for gems, although a number of stones have been cut and polished. In the Jenks mine, at Franklin, in Macon County, N. C., while mining for corundum, over fifty rubies and sapphires were discovered, of which nearly one half were really fine gems. The colors were blue, violet blue, pink, yellow, and ruby red. The smaller gems were the richest in color, and a few of the best found here were sold for nearly a hundred dollars each. Rubies, with their invariable associates, sapphires, have also been discovered near Helena, Mont., near Santa Fe, N. M., and in Colorado and Arizona. In this gem-producing district, formed by a part of New Mexico, Arizona, and southern Colorado, rubies and sapphires occur in sand, and are particularly found on ant hills, which abound there, associated with peridots and garnets. Perfect red rubies and blue sapphires have occasionally been found, but most of the gems are of a light green, greenish blue, light blue, light red, and red color, with also the intermediate shades. Though no mining or systematic search has ever been prosecuted in this wonderful district, rubies and sapphires sold and cut into gems bring annually over $2,000, not including the large number that is disposed of as specimens for mineral cabinets.

From the earliest ages of antiquity the ruby has been regarded as one of the most valuable of gems. An Eastern legend runs that a ruby was suspended in the ark of Noah to diffuse light, and the Vedas of the Brahmins mention a place lighted by rubies and diamonds, which emitted light like that of the planets. In China and India rubies have been employed from the earliest times for the ornamentation of a great variety of jewelry. They are also mentioned in the Bible, in the Proverbs of Solomon and in the twenty-eighth chapter of the book of Job, in verse eighteen: "No mention shall be made of coral or of pearls; for the price of wisdom is above rubies." The anthrax of Theophrastus and the Indian carbuncle mentioned by Pliny were undoubtedly rubies, as the following description by an ancient writer confirms beyond doubt: "The carbuncle or anthrax is an elegant stone of a deep red color, which when held against the sun resembles a glowing coal. It is found pure and faultless, and of the same degree of hardness with the sapphire, which is only second to the diamond. It is naturally of an angular figure, and bears fire unaltered and without parting with its color." It is the third stone mentioned as being in the breast-plate of the Jewish high priest, under the Hebrew name of *baraketh*, translated carbuncle, and it is also found among the royal ornaments worn by the king of Tyre (Ezekiel xxviii. 13). In several European museums are ancient cameos and intaglios engraved on rubies, about B. C. 500, which, as the historical reader is aware, was one of the most flourishing periods of Greek art.

The number of large and fine rubies that has been discovered—not including those in the Burmese treasury, of which little is known—is very small. The largest ruby of which there is any record is reported, upon the authority of Marco Polo, to be in the possession of the King of Ceylon. "It is a span long (nine inches), as thick as a man's arm, and without a flaw." In the French crown, adorning the order of the Golden Fleece, is a fine ruby cut in the form of a dragon with extended wings.

Hygiene of the Eye.

Dr. F. C. Heath, of Indianapolis, says: Rest should be considered as one of the most important factors in treating diseased or strained eyes—rest of eyes, body and mind. Avoidance of wind, dust and smoke, or protection from their evil effects, must not be neglected.

Personal habits enter into the question of causation of eye disease, and their regulation becomes, therefore, a part of the preventive or hygienic treatment. Sexual excesses undoubtedly contribute to the production of muscular asthenopia and hysterical amblyopia and photophobia, besides affecting the conjunctiva indirectly through their influence on nasal catarrh. Tobacco and alcohol have their well recognized amblyopias. Lack of bathing the eyes properly may result in conjunctival trouble. Use of water, both cold and hot, may have a place in the hygienic treatment of diseased eyes. Employ, as a rule, that which is the more grateful to the patient, cold usually for conjunctival diseases and injuries, hot for iritic and deeper troubles, avoiding anything like a poultice. Indeed, there should be a limit to cold applications, lest the nutrition of the cornea become enfeebled, while that delicate tissue requires still greater care in the use of hot applications (seldom exceeding one hour at a time), from fear of maceration and consequent ulceration. Diet is important, chiefly through its effects upon indigestion and general health, which frequently have much to do with the condition of the eye.

A few words as to abuse of eyes may not be amiss. The first offense in this line is reading with a poor light—requiring the ciliary muscle to do extra work to sharpen the vision. This applies to dim light, twilight, sitting too far from the light, etc.

The second offense is error of posture—stooping or lying down congests the eye, besides requiring unnatural work of the eye muscles.

Reading on trains is our third offense, the motion causing such frequent changes of focus and position as to tax the muscle of accommodation as well as the muscles of fixation, so to speak.

Reading without needed glasses or with badly fitting ones is our last, but not least, offense. Aside from the various well known reflex effects of eye strain, the danger to the eye itself is not to be slighted. Eye strain is certainly a factor in producing disease of almost every part of the eye, its most serious effects being choroiditis, glaucoma and cataract.

Old age is the time of retribution for eye sinners—it calls for little in a special hygienic way beyond the occasional stimulating washes and the careful husbanding of what sight remains.

Fortunately the surgeon's skill can give nearly all sufferers from cataract a greater triumph over their troubles than is afforded any other sufferers whatever, yet it is only after quite a period of darkness in waiting the ripening of the cataract.

Accidents from Thawing Dynamite.

The most fruitful source of accidents with dynamite is the thawing of the cartridges, which solidify and become inert at a comparatively high temperature, namely, about 40° F. To thaw the cartridges, tin warming pans are, or should be, provided, and if used with ordinary care, they form a safe and efficient means of carrying out this operation. They are constructed on the principle of the glue pot, the cartridges being placed in the removable portion and covered up, the bottom part being filled with warm water. So reasonably safe is the use of this contrivance that the author can only recall one instance of an accident occurring in its use. On the other hand, a very large number of persons have been killed, and a still larger number seriously injured, and much property destroyed through the improper thawing of dynamite. Much misapprehension and misplaced confidence has been caused by the fact that small quantities of unconfined nitroglycerine, and explosives containing it as their chief constituent, will sometimes burn quietly away when ignited by direct contact with a flame. It has, therefore, been thought that if this was the case, no ill effects could arise from simply heating it. This idea, as the author has already observed, is a terribly mistaken one. If a cartridge of dynamite or its congeners is lighted or placed in a fire, it may burn harmlessly away. But if a similar cartridge is placed on the hob of a stove or an oven, and gradually heated up to its exploding point, which is from 350° to 400° F., a violent explosion will almost inevitably result, and before that point is reached the explosive will become extremely sensitive to the slightest shock. Nobel states that, when dynamite is heated to 440° F., it is liable to explode. But Nobel is the apostle of dynamite, and is liable to look a little too favorably upon its faults. Colonel Cundill, one of her Majesty's inspectors of explosives, gives 360° F. as its exploding point, and Eissler, in his work on explosives, states that when dynamite is heated to 350° F., a dime falling upon it will explode it.—*B. F. Nursey, Society of Engineers.*

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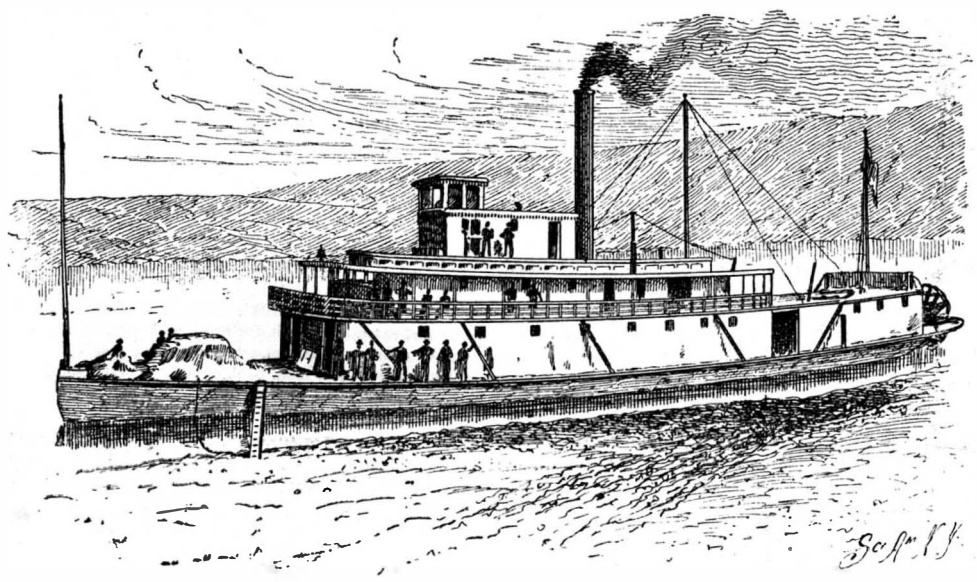
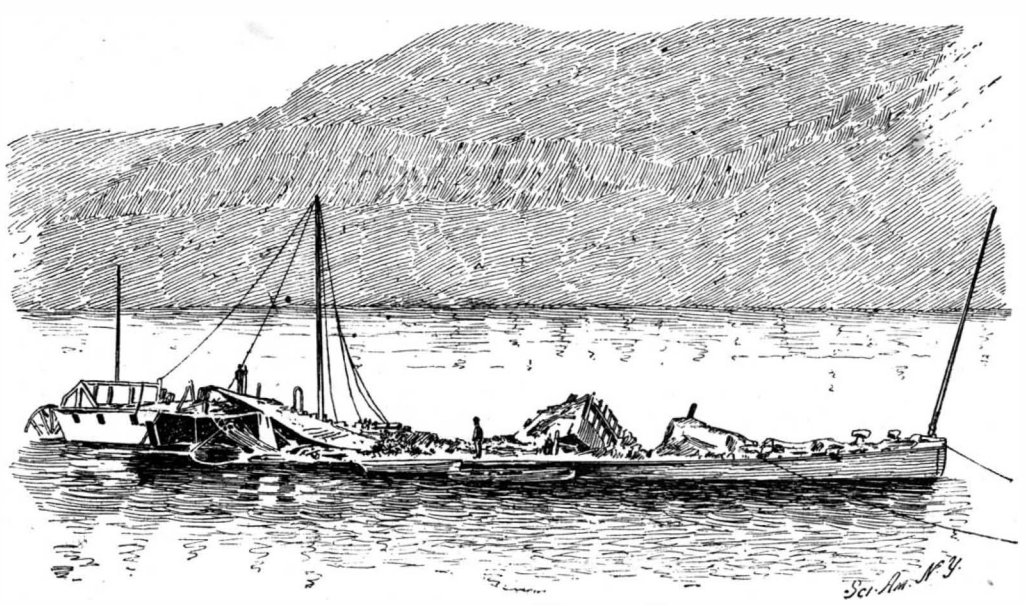
A STEAMBOAT EXPLOSION.

Steamboat boiler explosions attended with loss of life are few in number, and the entire history of Northwestern steam boating records a bare half dozen of these distressing fatalities. What was probably the most terrible accident of this nature that ever happened on the Northwestern waters took place on Snake River, August 14, when the boiler on the Annie Faxon exploded, killing eight people, wounding nine others and making a total wreck of the fine steamer. The steamer, in command of Captain H. C. Baughman, with George Brown engineer, left Lewiston, Idaho, on her regular trip to Riparia about daylight, and at 7:20 A. M. started to land at Wade's landing. In making the landing the engineer received a "go ahead" bell, and was in the act of answering it when the explosion occurred. The boiler was torn asunder and literally blown to pieces, a considerable portion of it being missing from the debris that remained on her decks. The accompanying illustrations, taken before and after the wreck, give a good idea of the awful destruction. A rigid examination by Inspectors Edwards and McDermott has thus far failed to reveal the cause of the explosion. The boiler was in good order, and at the time of the explosion was carrying ten pounds less steam than was allowed. The fusible plug, which would melt when the water became low, shows no sign of trouble from that cause, and from indication the exact cause will never be known.—*Railway and Marine Gazette.*



BEFORE THE EXPLOSION.



AFTER THE EXPLOSION.

A Boiler Explosion.

Boiler explosions are by no means uncommon, and yet they are seldom observed by "disinterested spectators." One of our inspectors from the Hartford office had the good fortune a short time ago to actually see a boiler blow up under steam at a high pressure. The boiler was torn apart and thrown in various directions. The inspector relates his experience as follows:

"About 12.30 o'clock on the afternoon of August 14, my attention was attracted by a fire which had just broken out in a shingle mill at North Adams, Mass. The flames spread rapidly, and were fast consuming the wooden mill and communicating with the adjoining buildings; and when the fire department arrived and got to work it bent its entire efforts upon saving the surrounding property. Hence no water was thrown on the burning building in which the boiler was situated.

"The boiler was of the locomotive type, and was rated at about 35 horse power. It was unjacketed and all its parts were exposed to the elements. It was provided with a two-inch pop valve, which would be of ample size to relieve it of excessive pressure under working conditions. The boiler, being under our care, was recently inspected, and was in good condition for a working pressure of 110 pounds to the square inch.

"The mill was situated on the bank of a small pond and the boiler was set at right angles to this bank. The position taken by the writer at the time of the explosion was on the opposite side of the pond, about 200 feet away from the mill.

"The boarding which covered the mill soon burned away, leaving only the frame and the stock for about 250 panel doors. This stock had been piled over the boiler to dry, and when it was released by the burning away of the mill it fell down about the boiler in a heap and burned fiercely, so that the entire outer part of the shell became the heating surface of the boiler. The safety valve was blowing freely, and could be heard distinctly above the roar of the flames. It was doing its utmost to relieve the enormous pressure that was fast accumulating. The iron stack had fallen into the pond and the smoke arch at the front end had become red hot. A few moments later there came a deafening explosion, like the report of a blast, and the burning timbers were hurled in every direction. One piece, about 6 inches square and 8 feet long, which was probably over the point of rupture, was thrown high in the air, so that it was hardly visible to the eye; it must have gone up 300 or 400 feet. The point of initial rupture was on the top of the barrel and the boiler was torn in three pieces. The front end was thrown into the pond, about 50 feet from where it stood before the explosion; and the fire box end, with the protruding tubes, was blown about 75 feet in the opposite direction, narrowly missing two firemen who were standing by. The central portion of the barrel was laid flat on the floor where the boiler stood.

"Investigation showed that the boiler was nearly filled with water at the time of the explosion. The shell above the water line had been overheated and softened, and the enormous pressure that accumulated caused the explosion. The shell was bulged outward in several places along the top to a depth of nearly half an inch."—*The Locomotive.*

Foundations in Quicksand.

A novel method of making foundations in quicksand was described by Mr. F. Neukirch, of Bremen, at the International Congress of Engineering, Chicago. The sand on which the foundation is to rest is converted into solid concrete by blowing into it, by air pressure, dry cement in powder. For this purpose a 1½ in. pipe is used, which is drawn to a point at its lower end, and has there three or more ⅜ in. holes. This pipe is joined at its upper end by a rubber tube to an injector, which is connected to a source of compressed air, and is fed with dry cement. The sinking of the pipe to the depth required is facilitated by blowing air through it during its descent and setting it in motion. Depths of 16 ft. to 19 ft. can thus be quickly reached. This done, the cement is fed in, and is carried into the sand by the air, which, boiling up through the former, insures a thorough mixture of it and the cement. The tube is then slowly withdrawn, the supply of cement being continued till it reaches the surface. The concrete formed in this way takes several weeks to harden, and requires months to attain its full strength. The whole area to be treated is divided into a number of small areas of about one square foot each, and the tube is sunk successively in all of them. It is found that the mixture of cement and sand produced occupies less space than the sand alone did before the operation. The method has been, it is stated, successfully applied to the water tightening of an iron coffer dam at the harbor of Vegesack, Bremen, and to a similar purpose on a sewer laid in quicksand in a narrow street. The sewer, which was egg-shaped, was very leaky—so much so that the sand passed into it, and was carried away with the sewage. Settlement then took place, and it was to prevent this going further that the "air" grouting process already described was adopted, and proved quite successful.

Progress of Refrigerating Industries.

With regard to ice manufacturing and refrigerating machinery, the *Engineer* remarks that during the year the progress has, on the whole, been satisfactory. There has not been much demand for large ice-making plants, chiefly because of the low price of Norwegian ice, but now that attention has been called to the desirability of using pure or distilled water ice for dietetic purposes, it is probable that the demand will improve. That machine-made ice can be produced at a less price than that of ice imported from Norway admits of no doubt whatever, and an ice factory must be a commercial success, provided it is put up with reasonable skill and with due regard to the wants of the particular district. Already in England large factories are successfully working in London, Birmingham, Hull, Liverpool and Manchester, as well as in other large towns. In warm climates the conditions are, of course, still more favorable for the artificial production of ice than in temperate climates such as that of England. The day of the compressed air refrigerator is at last over, and this seems to be true for machines both for land and ship use. At the present time, probably, no less than 80 per cent of the dead meat imported into Liverpool from North and South America is brought over by means of ammonia compression machines, and it is only a question of a comparatively short time until the few remaining vessels still using compressed air machines are fitted with more modern appliances, not only costing less to install, but requiring merely about one-fifth of the driving power. In the New Zealand and Australian trade, Messrs. Turnbull, Martin & Co.'s new boats, Perthshire and Buteshire, each of which will carry about 2,500 tons of frozen meat and dairy produce, are fitted with Linde machines on the air circulating system; and a third vessel, similarly equipped, has just been ordered by the same firm. The Gothic has a chemical machine on the carbonic acid system, with brine pipes; but in view of recent rather alarming reports from the River Plate, further experience is required before the success of this system can be said to be assured. With working pressures reaching as high as 1,200 pounds per square inch in the tropics, and with a critical point as low as 88 deg. Fah., it is rather difficult to see how such a liquid as carbonic acid can be satisfactorily used, except perhaps in some special cases. Linde machines are now used extensively for mutton and beef freezing and storage in South America, New Zealand, and Australia; and the Queensland Meat Export Company has just recently ordered two large plants for Brisbane and Townsville, each capable of freezing 600 tons of beef per month, and of simultaneously storing 600 tons at 10 deg. Fah. At Townsville the initial temperature of the cooling water is 100 deg. Fah. In this country a large chilling and cold storage plant is in course of construction for the Manchester Corporation, and a large extension is in hand for the Liverpool Cold Storage and Ice Company. Refrigerating machinery—chiefly on the ammonia compression system—is now used very largely by butchers, poulterers, and others, who find that with a well-constructed cold chamber they can not only supply better conditioned meat, but they can themselves take advantage of fluctuations of the market, and so make an additional profit. For industrial purposes the field is daily increasing, and it is surprising to think of the many instances—unknown till a few years ago—in which refrigerating machinery is now economically adopted.

Cristalline.

This is a kind of collodion in which the ether and alcohol are replaced by methylic alcohol as a solvent. It evaporates more slowly than ordinary collodion and forms a durable translucid pellicle, said to be imperceptible on the skin. It has been employed in combination with various medicaments in cases of skin disease, and readily dissolves pyrogallic and salicylic acids, chrysarobin, sublimate, etc. By the addition of castor oil an elastic cristalline may be obtained as in the case of collodion.—***Sem. med.*** **and** ***Repertoire*** **[3].**

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RECENTLY PATENTED INVENTIONS.

Railway Appliances.

AIR BRAKE VALVES.—Eugene Bearss, Ellenville, N. Y. This inventor has provided a new and improved device for opening or closing valves for air-brake hose couplings, one which automatically shuts the valve in each section when the sections are uncoupled, or opens the valve when two sections of couplings are united. There is a valve in each of two movable interlocking sections and a spring-pressed pivoted arm held on each section and adapted to engage with its forked end the handle of the valve in the section. By a special construction of the valve seat an air-tight joint is formed.

CAR AXLE DUST GUARD AND OIL SAVER.—William A. Warman, Moncton, Canada. This is a simple and inexpensive device, readily adjustable to various sized axles, and which adjusts itself to take up any wear of its various parts. It consists of a rigid bearing frame, or plates having packing material between them, and a vertically movable plate carrymg a sheet of packing material adapted to act in conjunction with the stationary packing and envelop the axle or shaft, the several parts being securely held, but at the same time properly spaced to permit the motion of the movable section.

CABLE CAR TRANSFER DEVICE.—John T. Schweizer, Wilmington, Del., and Jacob H. Burger, Philadelphia, Pa. The car-transferring mechanism provided for by this improvement is located in an underground chamber at intersecting points in a cable line, and consists of a sprocket chain carried by idlers and adapted to be operated from the power cable, while arms on the car may be set to engage the chain, whereby the car may be driven across other cables or cable conduits.

NEW BAGGAGE RACK.—Mr. R. H. Pannill, of the Chesapeake and Ohio Railway Company, has made an improvement in baggage racks for cars and stations that meets with the general approval of railway people. It facilitates the handling of baggage and economizes space.

Electrical.

VOTING MACHINE.—John H. Scotford, Portland, Oregon. This machine is designed for use in connection with what is known as the "Australian" system of balloting. It has a cylinder adapted to carry a ballot, a contact wheel and a numbering and registering device operated by an electric magnet, the connections being such that when the cylinder is revolved with a ballot on it, the numbering and registering device will be operated to count and print the vote, so that when the polls are closed the aggregate vote for each candidate will appear registered in a definite manner.

ELECTRIC WASHING MACHINE.—John P. Johanson, New York City. According to this improvement, two electrodes are provided, each having an insulated handle with a catch to support the electrode on the washboiler, while a metallic perforated tube is inserted in the handle and connected with the conducting wire, there being an insulated cap on the end of the tube opposite the handle. By this means the clothes, as they are being boiled, are treated to an electric bath to loosen and dissolve the dirt, the clothes being stirred occasionally and the dirt dropping to the bottom without the least possible injury to the fabric.

ELECTRIC RAILWAY TROLLEY.—Walter Van Benthuysen, New Orleans, La. The trolley pole, according to this invention, is formed of a hollow arm held normally in a vertical position by spiral springs, while a rod inserted in the arm has a projecting jointed end piece carrying a conical trolley wheel. The construction is such that the trolley is not liable to leave the wire, but should it do so, it will arrange itself automatically in a safe position, so that it cannot be injured by striking against the supports of the wire.

Mining, Etc.

AMALGAMATOR.—Doc. A. Patterson, Summitville, Col., and Emery Anderson, White Oaks, New Mexico. The pan of this amalgamator is of copper or other suitable material, galvanized or amalgamated, and it has the usual two parallel sides. A short distance from the upper gate is a transverse curved riffle, forming a pocket for quicksilver, and below this is a straight vertical riffle to agitate the flow; farther down in the pan is a gate, and beyond this is another riffle, reversely curved, while on the lower end of the pan is still another straight vertical riffle. The construction has been found very effective for catching and retaining all the precious metal contained in the pulp.

MULLER FOR GRINDING OR AMALGAMATING MILLS.—Walter N. Nolan, El Oro, Mexico. On the bottom of the pan of this mill is a die ring, on which travel a series of shoes, each having a beveled rim and conical feed apertures, the shoes each having a central stud revolving in a hub projecting from a circular plate secured to the under side of a ring-shaped carrier. In the carrier are apertures registering with those in the beveled rim and through which the pulp is introduced to pass on to the revolving shoe and between the lower surface of the shoe and the die ring. The shoes are free to slide upward in their hubs to admit more or less pulp between the grinding surfaces, and the muller, on account of its peculiar shape and construction, gives a rapid motion to the pulp, both when grinding and amalgamating.

TREATING PHOSPHATE ROCK.—George Guild, Knoxville, Tenn. This invention provides an apparatus comprising a hopper, a valve-controlled steaming chamber, a disintegrating chamber, and a screen. Means are provided for regulating the supply of material, and steaming and agitating it, and then screening and separating the phosphate from the mud, the work being very thoroughly done and the operation almost entirely automatic.

Mechanical.

SLIDING PLANER.—Arthur Stables, Mannborough, Va. In this machine is a reciprocating cutter head having inclined lugs which engage slides formed with angular recesses, while the feeding device comprises two sets of rollers journaled in side frames carried by a main frame mounted to turn, a shaft forming the center of the frame, and a pulley on the shaft being connected by belts with the uppermost feed rollers. The machine is strongly made and designed to plane a perfectly smooth and true surface. [For further information relative to this invention, address Eure, Gregory & Co., box 325, Norfolk, Va.]

MECHANICAL MOVEMENT.—José T. Penuela, Ciudad del Tocuyo, Venezuela. This improvement is especially designed for use in connection with sugar cane machinery, but is also applicable to crushing mills and other machines where great power or pressure is required. The invention provides a novel combination of cranks, levers, and falls, to be connected with the drive shaft and the machine to be driven, whereby the main shaft of the machine will be turned with greater power than the driving shaft, to overcome greater resistance.

BAND CUTTER.—Irene Hoyez, Stephen, Minn. Pivoted to a recessed handle is a blade which may be locked in open or closed position, while a second blade is secured to the free end of the first blade and held in fixed relation thereto when in use, the cutting edge of one blade facing that of the other and forming an angle therewith. The combined blades are arranged to close within the handle, forming an especially convenient tool for cutting belts or bands for thrashing and other machines.

Agricultural.

PLANTER AND DISTRIBUTOR.—Joseph N. Bell, Sharp, Ala. This is a simple, easily adjustable implement, which may be used as a planter or as a distributor for fertilizer. It comprises a beam or stock and a feeding wheel over which fits a removable bottom frame that rests upon the beam, the hopper fitting upon the bottom frame and being connected with the beam by straps. In planting cotton the machine has a different form of coverer and planting wheel from the devices used in planting corn and peas, etc., but the changes may be quickly made.

HAY LOADER.—William H. Scheer, Frankfort, Ill. As this machine is drawn forward the hay is gathered up by rake teeth which hold the hay until it is taken by conveyer teeth, removed from the gatherer and elevated for delivery into a wagon or other receptacle located in front of the machine and traveling with it.

COW MILKING MACHINE.—William B. Bland, Maquon, Ill. This is a machine which may be readily adjusted to the udder of a cow, and applied without causing irritation or discomfort, the milking fingers thereof being adjusted in any required direction, all the parts of the machine and the various adjustments being controlled by the working of a single lever. By the same lever also an operative mechanism is thrown into gear with the driving mechanism for operating the machine, the parts automatically adjusting themselves to compensate for the shrinkage as the milk is withdrawn from the udder.

Miscellaneous.

APPARATUS FOR DYEING.—Edward Turnbull, Passaic, N. J. This dye vat is mounted on wheels, and has at its rear end a small roller over which the fabric passes, and under a roller submerged in the dye. After which the fabric passes upward over a roller having a regular roughened surface, an endless rubber belt passing over an elastic covering on a cylinder pressing on the fabric as it passes over the roughened roller. The fabric is then passed back again into the dye, between other rollers, and receives a final pressure on a roughened surface as it passes out. No surplus dye or moisture is left in the fabric after it leaves the machine, which is designed to save considerable labor, and obviate the need of the ordinary scouring and finishing process, as well as do away with the necessity of heating the dye in the vats.

FILTER.—William D. P. Aims, Jr., Philadelphia, Pa. This is a filter adapted for use in filtering water, oil, or any other liquid, and for general domestic and manufacturing purposes. It is easily constructed and applied, and may be thoroughly cleaned without taking it apart or removing it from its position on the water pipe. In connection with perforated diaphragms near the top and bottom of a cylindrical casing are connecting porous tubes, through which the water or other liquid to be filtered is forced. The inlet pipe is connected with the top and bottom of the filter, so that the water or other liquid may be sent through it in either direction.

ALE-DRAWING DEVICE.—John Farmer, Jersey City, N. J. Either still or lively ale may, by this device, be drawn direct from the cask, means being provided whereby the same pressure of gas which exists in the cask will be present in the device or receptacle from which the ale is to be drawn. Means are also provided for reducing the pressure in the receptacle, and for determining the amount of pressure and the level of the liqnid. The receptacle and all of its interior mechanism are made of wood, and placed in a jacket adapted to receive ice.

HORSE COLLAR FASTENER.—Ernest E. Kerl, Mellette, South Dakota. This fastening consists of rigid members adapted to be attached to the sections of the collar, the members having a ball and socket connection whereby the collar will be permitted to work in a free and easy manner upon the horse's shoulders, and move in unison therewith, thus preventing the shoulders and upper portion of the neck from being galled or scarred by the action of the collar. The device is so made as to facilitate putting on and taking off the collar.

THILL COUPLING.—Isaac Clark, Morris Plains, N. J. This is an improvement upon a former patented invention of the same inventor, and provides a simple and conveniently manipulated device for holding the coupling in locked position. The coupling and uncoupling with the thill iron are quickly and easily effected, and the device makes an anti-rattling connection.

PUTTYING TOOL.—Theodore Witte, Chilliwhack, Canada. This tool has a three-cornered nozzle at one end and a handle at the other end, while a piston working in the body is provided with a racked piston rod moved by a gear and ratchet mechanism actuated by a swinging lever fulcrumed in the handle. Mixed putty, either hard or soft, may be carried in the tool, and be forced out and rapidly applied without the use of a knife and without touching the putty with the fingers, the putty being rubbed to place by a flat blade or plate at one side of the nozzle.

WATCHMAKER'S TOOL.—John A. Bricker, Atlanta, Texas. This invention relates particularly to a device for removing the roller from the balance wheel staff or the hands from their shafts, the device being so constructed that the wheel can be held in one hand while the instrument is fastened upon the roller by the other. The improvement provides a pair of spring-actuated pinchers connected with which is an adjustable centering pin, there being also a longitudinal guide rod connected with the handles, causing the latter and the jaws to move evenly.

PRINTER'S "TIE-UP" FOR TYPE PAGES.—Joseph Vierling, Allegheny, Pa. Instead of tying up pages of type with a cord or string, this inventor has provided a binder consisting of straight bars having rabbeted ends and projecting pins and tongues adapted to engage right-angular corner locking pieces in which are inclined slots. With the bars made type high to take the place of a guard rule, this binder may be used in electrotyping.

BOOK AND INDEX.—Thomas K. Brownell, Clifton, N. J. With this improvement an index book may be inclosed within the covers of a book of entry and extended with it for ready reference. The invention consists in the attachment of the index book to the tapes of the main book or book of entry, so that it is not liable to be detached except by the destruction of either or both.

COMBINATION TRUNK.—Abraham Botkin, New York City. This inventor has devised an article of furniture which may be used as a bed, a seat or a chair, as well as a trunk, while its top may also be utilized as a table. It is so constructed as to be convenient of manipulation, and is designed to have especial advantages for traveling salesmen carrying samples and sometimes having to put up where hotel accommodations are limited.

FIRE ESCAPE.—Francis W. Rawle, New York City. This fire escape is made in two sections, a hollow body section adapted to be secured to a fixed support just outside of a window and a folding carriage adapted to fit in the body section when not in use, the carriage having a lowering device connected with the body section and a brake mechanism, whereby persons descending in the carriage may regulate the speed of their descent.

STOVE.—Jorgen J. Eskil, Iron Mountain, Mich. In this stove a flue opening from the outer air beneath the ash box extends around the fire box into a hot-air chamber above, and the air thus heated passes out through openings in the top of the stove, which is thus adapted to afford heat by ejecting into the room a current of hot air as well as by direct radiation, affording a large amount of heat in proportion to the fuel consumed.

CHIMNEY CAP.—Martin Ludwig, Albany, Oregon. This top is formed of a single piece and provides in itself the vane for controlling the position of the cap; also providing for accelerating the draught by means of its air openings, and affording a secure support for the top. The flaps made by the incisions in the blank forming the top are bent to produce sheds over the air openings.

WASHING MACHINE.—Charles M. Coats, Aurora, Ill., and James L. Sprague, Minneapolis, Minn. This is an improvement in that class of washing machines in which a swinging rubber is suspended and reciprocated within a suds box, the operator vibrating handle levers by which the rubber and the clothes-holding cage are simultaneously oscillated. The clothes are thus subjected to three operations at once—rubbing or friction, squeezing or pressing, and the passage through them of mingled currents of air and water, which is designed to effect their cleansing in the shortest time, with little labor and the least wear.

BEDCLOTHES FASTENER.—Zebulon H. Jacobs, Salt Lake City, Utah Territory. A fixed cross bar is arranged between the rails near the foot of the bedstead, and between this bar and the footboard is a spring-pressed sliding fastening bar, between which and the footboard the lower ends of the bed clothes are clamped to prevent their being thrown off by a restless sleeper. A locking device is provided to hold the fastening bar out of engagement with the clothes while the bed is being made.

UTERINE RECTIFIER.—Frank W. Haviland, New York City. This is a device designed to be worn with safety and with but slight inconvenience for restoring a deflected uterus to its normal or proper position.

NOTE.—Copies of any of the above patents will be furnished by Munn & Co., for 25 cents each. Please send name of the patentee, title of invention, and date of this paper.

NEW BOOKS AND PUBLICATIONS.

THE IRON FOUNDER SUPPLEMENT. A complete illustrated exposition of the art of casting in iron. By Simpson Bolland. New York: John Wiley & Sons. 1893. Pp. ix, 392. Price $2.50.

Foundry work is now being studied in our colleges; it is no longer relegated to workmen, but is taught by practical demonstration to students in the higher institutions of learning. At last we have a full and adequate manual on the subject. While students have been alluded to, it must not be supposed that the work is written for them alone. Indeed, its aspect is a practical one, and the intelligent foreman and progressive workman will alike find matter to interest them in it, and it will appear as something designed to raise their trade above the rule of thumb system too apt to prevail. The numerous illustrations are especially to be commended.

OBJECT LESSONS AND HOW TO GIVE THEM. First series. For primary schools. By George Ricks. Boston: D. C. Heath & Co. 1893. Pp. vi, 202. Price 90 cents.

Students of pedagogy have found children educated in schools astonishingly ignorant of the concrete. This little text book is designed to bring it before them. It is the first series for the use of primary schools, and addresses the brain through the senses. It is very interestingly written, and while it indicates an advance in educational methods, it incidentally, and very curiously, shows therewith a startling defect, perhaps as much in the home life as school life of many children; namely, their ignorance of measurements and similar things.

OBJECT LESSONS AND HOW TO GIVE THEM. Second series. For intermediate and grammar schools. By George Ricks. Boston: D. C. Heath & Co. 1893. Pp. viii, 214. Price 90 cents.

The second series, designed for elementary and grammar schools, treats of elementary physics and chemistry and gives excellent hints for the simple demonstration of the laws of science. In some ways it is to be regretted that the apparatus shown is not simpler and that the use of an air pump is prescribed.

NATURAL THEOLOGY. The Gifford lectures delivered before the University of Edinburgh in 1893. By Prof. Sir G. G. Stokes, Bart. London: Adam and Charles Black. 1893. Pp. viii, 272. Price $1.50.

The relation of science and religion and the concordance between science and revealed religion are the topics of this work. If we undertook to review it, it would possibly bring us into too lengthy a discussion. It will, it is believed, be found acceptable for many readers.

THE RELIGION OF SCIENCE. By Dr. Paul Carus. Chicago: The Open Court Publishing Company. 1893. Pp. vi, 103. Price 50 cents.

☞Any of the above books may be purchased through this office. Send for new book catalogue just published. MUNN & Co., 361 Broadway, New York.

SCIENTIFIC AMERICAN BUILDING EDITION.

JANUARY, 1894.—(No. 99.)

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1. Elegant plate in colors showing a suburban dwelling at Bridgeport, Conn., recently erected for L. D. Plumb, Esq., at a cost of $4,500 complete. Floor plans and perspective elevation. An excellent design. Mr. C. T. Beardsley, architect, Bridgeport, Conn.
2. Plate in colors showing the residence of Thomas C. Wordin, Esq., at Bridgeport, Conn. Two perspective views and floor plans. Cost $3,600 complete. Mr. Joseph W. Northrop, architect, Bridgeport, Conn.
3. A colonial dwelling erected for Philip Lucas, Esq., at Mount Vernon, N. Y. Perspective and floor plans. An excellent design. Cost $7,000 complete. Mr. Louis H. Lucas, architect, Mount Vernon, N. Y.
4. A cottage at Cranford, N. J., erected at a cost of $5,000. Floor plans, perspective view, etc.
5. Engravings and floor plans of a suburban residence erected at Brookline, Mass. Mr. E. L. Rodgers, architect, Boston, Mass. A very attractive design.
6. A dwelling recently erected at Elizabeth, N. J., at a cost of $5,500. Floor plans and perspective elevation. Mr. J. E. Baker, architect, Newark, N. J.
7. A new frame schoolhouse at Elizabeth, N. J., erected at a cost of $16,000 complete. Elevation and floor plans. Messrs. Charlock & Howard, Elizabeth, N. J., architects.
8. A dwelling recently erected for W. E. Clow, Esq., at Buenna Park, Chicago, Ill. A picturesque design. Two perspective views and floor plans. Mr. Greg Vigeant, architect, Chicago.
9. A town library of moderate cost at Colchester, England. Perspective view and plans.
10. A house at Cambridge, Mass., erected at a cost of $6,000. Mr. J. T. Kelly, Boston, architect. Perspective and floor plans.
11. Restoration of the Pantheon at Rome. Half page engraving.
12. Miscellaneous Contents: A rival to oak.—Seaside painting.—Miscellaneous weights.—Water tanks.—Improve your property.—Cement.—Peruvian ruins.—Ornamental iron and brass work, illustrated.—Facts for builders.—The Goetz box anchors, post caps, and hangers, illustrated.—Improved gas grate, illustrated.—Improved drawing instruments, illustrated.—Climax gas machine, illustrated.—Improved square chisel, mortiser, and borer, illustrated.—Adamant brush finish.—Patent stair gauge, illustrated.

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Business and Personal.

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Pipe frame truck baskets, steel and wooden trucks, etc. L. M. Moore, Rochester, N. Y. See page 399.

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For Sale—Puttying tool patent. See page 76. Address for terms and particulars, Theodore Witte, Chilliwhack, British Columbia.

Models and experimental work. Small articles made in quantity for the trade. For catalogue, etc, write L. G. Winn Mfg. Co., Indianapolis.

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The best book for electrician and beginners in electricity is "Experimental Science," by Geo. M. Hopkins. By mail, $4; Munn & Co., publishers, 361 Broadway, N. Y.

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Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters, or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

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Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(5739) O. V. S. asks: 1. I want to make a motor from the hand power dynamo described in SUPPLEMENT, No. 161, for running sewing machine. I am making drum armature with 12 coils. What size wire must I use on field and armature to run from storage batteries, each cell having 8 plates 4⅛×8? A. Wind the field to a resistance of 5½ ohms, with No. 21 wire. Wind the armature to a resistance of 6 ohms. Use wire of size to give this resistance. 2. What is the amperage of such a cell? A. One and one-half amperes. 3. When cell is formed, how many gravities will it take to charge it? A. Two and one-half in series for each cell, and enough in parallel to give nearly 1½ amperes of current. 4 How long will it take to charge? A. Ten hours if you have current enough. 5. Can I run a 1 gallon plating bath with 1 cell, nickel plating? A. Yes. 6. How many storage cells will it take to light a 2 candle power lamp two hours each night, batteries being charged during daytime with gravity cells? A. Three cells. 7. In making plates for storage battery should they be punched full of holes and filled with red lead? A. You may do so. See our SUPPLEMENT, Nos. 845, 838, 159, also SCIENTIFIC AMERICAN, No. 2, vol. 61, No. 20, vol. 69, No. 9, vol. 68, for storage batteries. 8. How long will the plates last when in constant use? A. With care, for several year. If not rightly treated, they may deteriorate in a few days.

(5740) M. E. C. asks: 1. I have motor wound for the incandescent circuit of 110 volts, 2 amperes. I wish to use it on an arc light circuit of 2,000 volts, 9½ amperes, the voltage at the point where the motor is to be inserted being 1,000. Could I accomplish this by a branch circuit? A. Between the points of attachment of your branch a resistance of 1/18 of that of the field magnet of your motor must be placed. This is approximately 40 ohms. The resistance must be capable of passing 7½ amperes. 2. Would it do to solder the smaller wires at points of connection? A. Twist and solder. 3. Is it possible to run an alternating motor by a battery current passed through an induction coil? If so, are such motors manufactured, and by whom? A. Yes. Address the Westinghouse Electric Company, Pittsburg, Pa.

(5741) H. A. J. asks: Will you please answer the following questions? What kind of wire is the core of an induction coil made of, and how many feet of wire will it take for both primary and secondary, also how much of each? I would like to make a shocking battery to give from 50 to 100 volts. A. You will find excellent articles on induction coils in our SUPPLEMENT, Nos. 160, 166, 229, 569; a coil is very seldom made for so low a voltage. Those described by us run up to thousands of volts. A simple spark coil with iron wire core ½×6 inches, wound with two or three pounds No. 20 wire, with a circuit breaker, would answer your purpose.

(5742) A. H. B. says: Suppose a reservoir elevated 50 feet has two discharge pipes each 3 inches in diameter, perpendicularly from the bottom. One pipe 1 foot long, the other 40 feet long, both discharge into the open air. Will one pipe empty it quicker than the other, and if so which one? Also what would be the result if the pipes were ¼ inch in diameter, same length? A. The long pipe will empty the reservoir the quickest in both cases. The short tube has only the hydrostatic pressure of the head of water in the tank, while the long tube has the suction due to a vacuum in addition to the hydrostatic head of the reservoir, less the retardation due to friction of the water in the pipe, which is small.

(5743) J. D. asks: 1. Can caustic soda be substituted instead of caustic potash in the caustic potash batteries described in "Experimental Science"? A. Yes. 2. If so, what would be the current and E.M.F. of a pint cell using this solution? A. About the same as for caustic potash, from ½ to 1 volt, and low internal resistance.

(5744) W. S. L. asks: What zinc surface is necessary in a bichromate battery to produce one ampere of current? That is, what surface must be exposed to the fluid? A. This depends on the external resistance. With low resistance, a zinc plate of two or three square inches immersed area would answer. Large carbon plates operate to prevent polarization and so tend also to maintenance of a high potential, with consequent current.

(5745) W. J. S. asks if there is anything through which a horseshoe magnet will not draw; for instance, if you put a needle on one side of a glass and the magnet on the other, the needle will follow the magnet. A. A plate of iron will, by absorbing most of the lines of force, cut off the attraction of a magnet for iron on the other side of it.

(5746) J. T. asks how carbons are plated with copper, as I wish to make carbon brushes for exciter for dynamo. I find that carbon works better than copper, not wearing the commutator so much. A. Electroplate by regular process, in a copper sulphate (blue vitriol) bath.

(5747) M. N. J. writes: 1. Suppose an oscillating body making 40 oscillations per minute, requiring 2 pounds pressure at each oscillation. If the motive power be supplied by compressed air, pumped by an ordinarily strong person, what percentage of time would it require to keep the body moving?—the compressed air to be pumped into a tank and power applied by some form of valve and piston action. A. You must give the distance the force must be applied through, whether the body is to be pushed for an inch or a foot, or for what extent of motion. Mere pressure requires no energy. 2. Has the idea any great disadvantages to overcome? A. None that we can see. The clock pendulum and escapement are an example.

(5748) R. H. asks: 1. How is the unicycle described on page 20, January 13, 1894, steered? A. Unicycles are steered by balance. Shifting the center of gravity to one side turns them in that direction. 2. Also please state of what and how hard rubber is made. See our SUPPLEMENT, Nos. 249, 251, and 252, for an excellent treatise on the manufacture of all kinds of India rubber.

(5749) G. W. D. asks: Would it be practical to run a cream separator with a motor and furnish the electricity by a gravity battery and a storage battery? If so, what would be the cost, and could a person not an expert put it in? Where can I get them, and could I make the gravity battery? A. It would be practical, except that a great many gravity battery cells would be required. To charge a single cell at the full rate 50 gravity cells per square foot of positive plate would be needed. You could make the gravity battery. A certain amount of expert knowledge is needed, especially in running the storage battery.

(5750) H. C. R. asks for the best substance, wood or compound, that would give the greatest amount of expansion when immersed in water at boiling temperature. Object, to secure a limited pressure from said expansion. A. A zinc rod gives the greatest amount of expansion among the metals. A hard rubber rod of same length will have a greater amount of expansion.

(5751) M. C. C. writes: 1. Will the inclosed sample of wire give good results if used in making core of armature for motor described in SUPPLEMENT, No. 641? A. Yes. It would be well to oxidize and shellac it first. 2. How many pounds of No. 16 wire does the field require? A. 3½ pounds. 3. How many pounds of No. 18 wire does the armature require? A. 2½ pounds. 4. Is it single or double covered (cotton) magnet wire? A. Double covered is preferable. 5. How many convolutions are there in each layer of field magnet? A. 34 feet. 6. What is the resistance of motor as a series machine? A. 2 ohms if wound with No. 16 wire on armature, 2·6 ohms if with No. 18. 7. Could I change it to a shunt machine by simply changing the size of wire in field and not in armature, and if so, how much? A. The motor is described as shunt wound. The winding has to be adapted to the potential maintained or to the combination of external resistance and potential, according to circumstances.

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January 23, 1894,

AND EACH BEARING THAT DATE.

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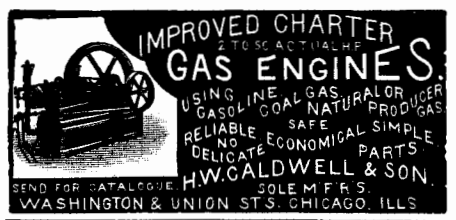
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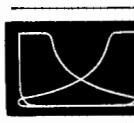
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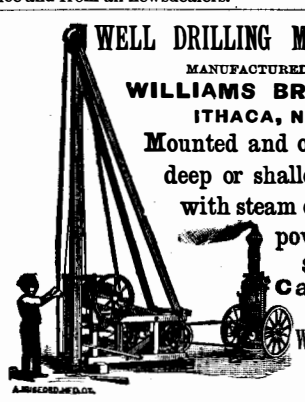
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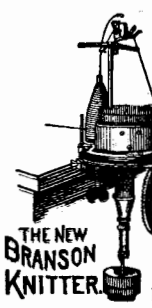
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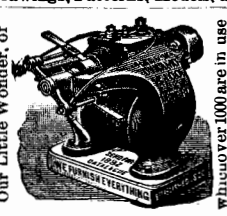
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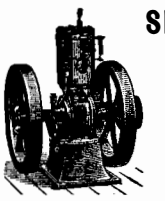
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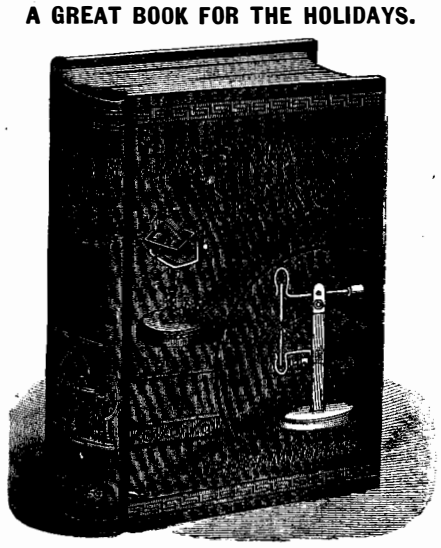
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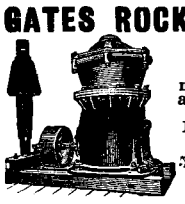

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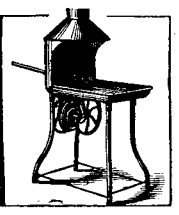

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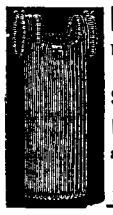

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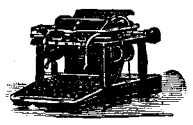

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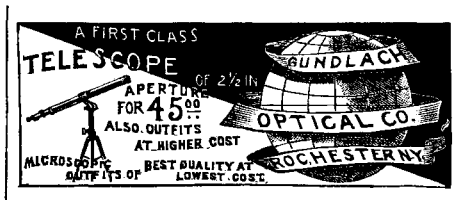

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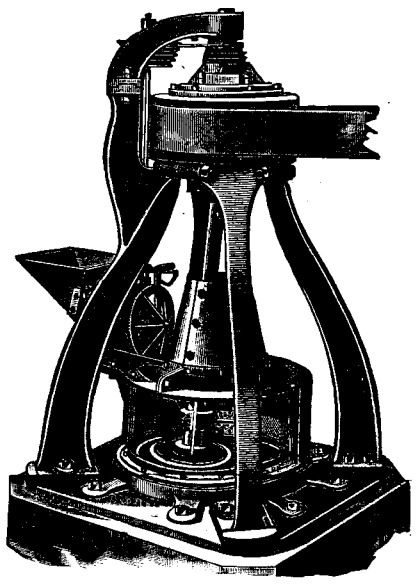

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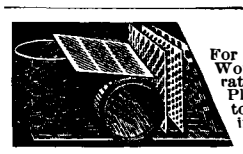

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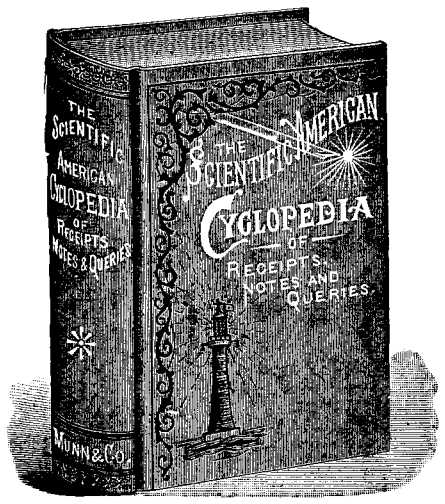

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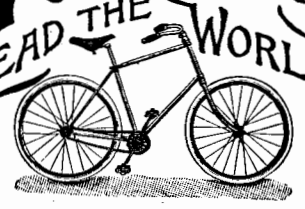

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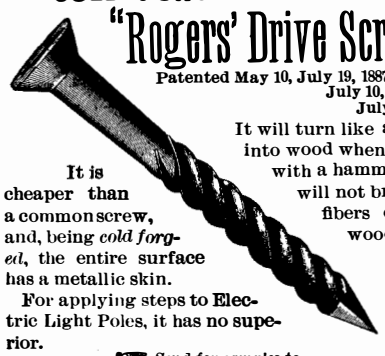

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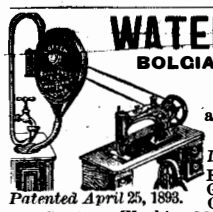

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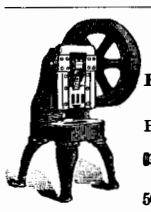

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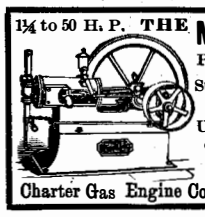

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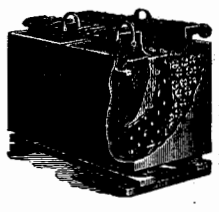

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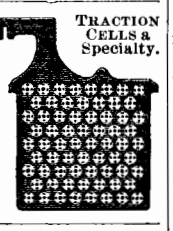

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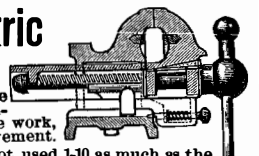

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